THE WASTE OF WATER.*

The attention of successive city councils has repeatedly been called to the necessity of adopting measures for preventing waste of water. Notwithstanding what has been written and said upon the subject, no determined and sustained effort has yet been made to check the evil. When threatened with scarcity of water the remedy has been to extend our sources of supply, and appropriations for that purpose have been readily granted. Nevertheless the purpose has not been accomplished; the consumption of water has kept pace with the supply, and this is largely due to wanton waste and not to the use of water for legitimate purposes. The subject, however, assumes a graver aspect when it is understood that, unless some method is adopted for checking waste, the limit of the Sudbury River supply will be reached in the near future, and new sources will have to be developed.

The capacity of the present water supply of Boston from Sudbury River and Cochituate Lake amounts, in a year of least rainfall, to about 29,000,000 gallons per day, equivalent to a supply of 85 gallons for each inhabitant, calling the population of that part of Boston supplied from these works 340,000. The new storage basin, which is now being constructed on a branch of the Sudbury River at Ashland, will increase the supply about 5,000,000 gallons per day; but the basin will not be completed for two years, and in that time the increase of population, if the present rate of consumption is maintained, will exhaust the full capacity of the works, and the construction of another basin will have to be commenced.

The storage facilities of Sudbury River valley can be developed by the construction of additional basins, so that a supply of about 38,000,000 gallons per day can be obtained; and the combined Sudbury River and Cochituate works can be relied upon for a daily supply of about 48,000,000 gallons. Allowing for the increase of population, and a slight increase in the rate of consumption, the capacity of these works will be reached in about twelve years. The cost of thus increasing the capacity of the works will be at least $500,000.

The average daily consumption during 1881 amounted to 31,000,000 gallons, or 95 gallons per head of population. A comparison of these figures with those given as the present capacity of the works in a year of least rainfall will show that, if such a year should occur before the completion of the new basin, the consumption would exceed the supply.

That this enormous consumption is unnecessary, and is due to illegitimate use and wanton waste of water, is shown by the following table giving the consumption per head of other cities, and also by the fact that when, about twenty years ago, the consumption of Boston reached a rate equal to the present one, a vigorous inspection reduced the amount to a reasonable quantity, and saved for many years the large expenditure which had finally to be made for the construction of the Sudbury River Works:

CONSUMPTION OF WATER PER HEAD OF POPULATION.

	Gallons.
Brooklyn	54.2
Cincinnati	75.9
Cleveland	63.6
St. Louis	72.1
Liverpool	27.
Glasgow	60.
Providence	36.3
London (average of nine companies)	27.5

It must also be remembered that, in addition to the cost of extending the water-works, the expense of pumping at the improved system of sewerage works will be greatly increased by the extra quantity of water that is wasted and flows into the sewers.

If consumption of water could be reduced to 60 gallons per head, a very liberal quantity for all necessary purposes, the limit of capacity of the present works, including the basin now being constructed, will not be reached until 1900. If the consumption continues at its present rate $3,000,000 will have to be expended before that year for new works, and the interest on this, together with the cost of pumping the surplus quantity of water at the improved sewerage works, will amount in the same period to about $1,500,000, a total of $4,500,000.

There is no question but that 50 per cent. of our present water supply is wasted, and, further, the largest portion of this waste can be prevented without limiting the supply for all legitimate purposes, and without extraordinary expense.

The principal sources of waste of water are,—

1. Defective mains and services.
2. Defective fixtures in buildings.
3. Bad plumbing.
4. Wilful waste.

The loss from the first cause is comparatively slight. Street mains and services in this city are constructed of the best materials, and laid by skilled workmen in the most approved manner. Being under constant supervision, leaks of any extent are soon discovered and immediately stopped. A recent examination in the Charlestown District discovered only 24 cases of this kind, about one-quarter of which were small defects in stop-cocks at the curbs; and the whole amount wasted did not exceed 300 gallons per hour.

Under the head of defective fixtures may be included such as are constructed without regard to economy in the use of water, as well as such as are out of repair.

Among the former, water-closets that are supplied directly from the service pipe, and urinals in which the water is kept constantly running, are the greatest sources of waste.

The quantity of water used in the form of closet referred to, even with proper care, is much greater than is needed, but its chief fault is that users are in the habit of fastening the valve open, so as to keep up a continuous flow of water from a mistaken idea that a constant flow of water down a closet promotes cleanliness. An examination of the water fixtures in Charlestown, made during the past year, showed that a large part of the waste was due to this cause.

Another wasteful form of fixture is the self-acting closet, operated by opening a door or by seat pressure, by which a constant flow of water is maintained while the closet is in use.

The ordinary pan-closet, supplied by a tank and ball-cock, is frequently a source of great waste, in consequence of the valve and tap becoming worn. Careful attention would prevent this, but usually the slight dripple from the tank, as it does no harm, is either overlooked or neglected.

The following results of four cases recently examined will serve to illustrate the waste caused by defective water-closets.

Meters were placed upon a block of four houses at the South End, and the quantity of water consumed ascertained. An examination made about the first of May revealed the following defective fixtures:

CASE NO. 1.

Hopper cock to water-closet defective, and could not be depended upon to shut off the water when not in use.

Consumption 445 gallons per head.

CASE NO. 2.

Handle to hopper-cock furnished with the necessary appliance for fastening it, open. The owner was suspected of keeping it open (during cold weather at least), so as to permit a continuous flow of water down the closet.

Consumption 109 gallons per head.

CASE NO. 3.

Hopper-cock out of order and wasting.

Consumption 310 gallons per head.

CASE NO. 4.

Ball-cock in cistern defective, and would not shut off water when not in use.

Consumption 132 gallons per head.

The owners were required to repair the defects, and an examination made on the 24th of May showed the following result:

	Daily consumption per capita, before repairs. Gallons.	Daily consumption per capita, after repairs. Gallons.
Case No. 1.	445	21
Case No. 2.	109	36
Case No. 3.	310	73
Case No. 4.	132	73
Total	996	203

When it is understood that many thousand cases like the foregoing exist in Boston, the great loss from this source of waste will be appreciated.

In places where the subject of prevention of waste has received the attention it deserves, the use of the defective form of closet is either interdicted, or a proscriptive tariff is laid upon it. There are 1,069 urinals in Boston so constructed that a constant flow of water is kept up day and night. It is true that the stream is small, so small in fact as to be, in most cases, ineffectual as far as purification is concerned; but the waste is going on all the time, and the aggregate quantity of water consumed is very large. The waste from water-fixtures, that are out of repair, either from wear and tear or inferior materials and workmanship, cannot be estimated, but is probably much larger than from all other sources combined. A leaky faucet is usually neglected until it becomes a source of annoyance to the householder; for the only inducement to rectify it is his duty to the city—a duty which is liable to be thoughtlessly postponed.

On this point an English writer says:

"A little rill, trickling down a mountain side, looks very insignificant; nevertheless, little rills make big rivers. So with waste; a slight leakage from a tap may seem very unimportant; but slight leakages gradually exhaust huge reservoirs. A mere dribble from a tap, continued for years, represents in money-value the water-rate of an artisan's cottage."

Close competition in the manufacture of plumbing materials has caused great deterioration in quality, and the market is flooded with inferior water-fixtures. There is a close connection between the use of such fixtures, and what we term the third and fourth sources of waste, i. e., bad plumbing and wilful waste; for bad plumbing includes the use of poor material and unskillful workmanship, and both lead to waste.

Unfortunately, the plumber's work is usually concealed, and its defects are not discovered until damage ensues. An imperfect or unsound joint, from which the water oozes and follows down the pipe, may not be noticed until the leak enlarges under pressure and the premises are deluged. It is not until use reveals the defects that cheap fixtures show their unserviceableness, and contribute to the waste of water. Pipes placed where they will freeze unless a current is kept through them, lead to wilful waste; for, after one experience, with bursting pipes, the householder, with the recollection of damaged premises and plumber's bills on his mind, can hardly be expected to resist the temptation to let the water run. It is well known that a fall in temperature and an increase in consumption of water are coincident. In extreme cases the waste from this cause is from thirty-five to fifty per cent. of the amount supplied. Cold-weather waste is, therefore, one of the greatest sources of waste, and is likewise one that is due entirely to bad plumbing. The use of hand-hose for irrigation, although not strictly a waste of water when kept within reasonable limits, is a severe tax upon our water supply.

PREVENTION OF WASTE.

Prevention of waste does not mean stinting the supply; on the contrary, it means that every taker shall have a full and liberal allowance of water, sufficient for all purposes, but that the careless or indifferent shall not, by wanton waste, deplete the sources of supply, and increase the burden of taxation by necessitating their constant extension. Boston can easily afford to furnish an ample supply of water to all, but it cannot afford to have 12,000,000 gallons a day uselessly thrown away.

The principal methods of preventing waste are:

1. The meter system.
2. House-to-house inspection.
3. The waste-water meter system.

The meter system is, of course, the most effectual method of preventing waste. By it every taker pays for the exact quantity of water consumed. Self-interest is, therefore, directly appealed to, and the conservation of all water not actually required for use is effected.

As an illustration of the saving effected by the use of meters, a comparison between the cities of Newark, N. J., and Providence, R. I., may be of interest.

Newark, with 10,000 services and but few meters, has a daily consumption of 10,000,000 gallons and a revenue of $100,000; Providence, with the same number of services and about 5,000 meters in use, has an average daily consumption of 4,000,000 gallons and a revenue of $260,000.

House-to-house inspection answers very well for detecting and preventing waste proceeding from defective fixtures. In Cambridge, where the system is in operation, the consumption has been maintained at about 50 gallons per head. It was adopted in Boston in 1864, and continued for about 18 months. In 1861, the consumption was up to 100 gallons per head, and remained at or near that rate until house-to-house inspection was begun, when it fell to 66 gallons. The inspection was practically discontinued in 1866, but the effect was felt until 1872, when the Sudbury River supply was turned on. From that time it has gradually increased to its present amount.

Practical experience has shown that the most satisfactory, as well as least objectionable, method of preventing waste, is a combination of house-to-house inspection with the meter system, and vigorous inspection of plumbing—in other words, the waste-water meter system.

This system was invented by Mr. George F. Deacon, C. E., Water Engineer to the City of Liverpool, England, and is in successful operation in many European cities.

In Liverpool it effected a reduction of 60 per cent. in the consumption of water from 1873 to 1880, without detriment to the manufacturing or sanitary interests of the city.

The Chairman of the Liverpool Water Committee, in his address in 1879, speaks of the system as follows:

"We have given the city a constant service of water, with a decline in the death-rate, and it now remains for me to show what other effects have arisen from the change of system. In the year 1871 we delivered an average of 122,000,000 gallons weekly. In 1880 our deliveries will be about 115,000,000 gallons, and this, notwithstanding an increased sale for trade purposes of 12,250,000 gallons weekly, and an increased population of 104,000. The saving has been so great as to meet the increasing demands of the city and district for eleven years.

"The change to constant service has already yielded nearly a quarter of a million of money (£250,000,) and the ultimate saving to the rate-

* Report of the Joint Standing Committee on Water, city of Boston, instructed to investigate and report upon the best method of restricting the present waste of water.

payers, when the 7,000,000 gallons per week, yet unsold, are absorbed, will be £50,000 per annum."

In the Deacon system the waste-water meter is used to locate sources of waste. This meter does not, like the ordinary meter, record the number of gallons consumed, but it indicates the rate of flow at any given time, and whether the discharge is due to steadily flowing waste, or to intermittent and ordinary use. It, therefore, enables the observer to determine, by observations taken at those hours when no water, or a very small quantity, is used for legitimate purposes, whether waste is going on.

The meter consists of a hollow cone, having its small end upwards, and containing a composition disk, of the same diameter as the small end of the cone. A vertical spindle, attached to the upper surface of this disk, is suspended by a fine German-silver wire, which passes, practically water tight, through a small hole in the top of the chamber, over a pulley, and supports a weight. This weight is so adjusted as to retain the disk at the top of the cone when the water is at rest. When any water is drawn through the meter, the disk is pressed downward toward the bottom of the cone, its position depending upon the amount of water passing through the meter. By means of a pencil attached to the wire the motions of the disk are recorded on a drum, which revolves by clock-work, once in 24 hours.

The meter is placed in a box under the sidewalk or roadway, and so located as to control the flow of water supplied to a certain district, the limits of which have been previously determined. All the water used in this district is drawn through the meter, and the quantity and rate recorded. After a few diagrams have been taken, to show the ordinary rate of consumption, inspection is commenced. Every service-pipe is provided with a stop-cock, which is accessible from the sidewalk by means of an iron wrench about 7 ft. long. When this wrench is applied to the stop-cock the sound caused by water passing through the service-pipe can be easily distinguished. When no noise is heard, with the stop-cock fully open, it is partly closed, and the increased velocity always causes a distinct sound, although the quantity of water passing the stop-cock may be very small. A night inspector begins his work about midnight, and tests, by means of his shutting-off wrench, each service-pipe. If he discovers any flow through the service-pipe, the stop-cock is closed, and a note made of the time and the number of the house. He continues this operation through the district until about 4 a. m., when he retraces his steps, and opens all the stop-cocks he had found wasting. During this time the meter is recording the consumption, and the diagrams show the amount of water wasted by each of the service-pipes that were closed, the time the inspector began and finished his work, and the time each stop-cock was closed. The day inspector receives the night inspector's report, visits the premises where waste was noted, and ascertains the cause. In cases of waste from defective fixtures the owners are notified to repair the same, and the visits are continued until the notices have been complied with.

The economy of this system, as compared with house-to-house inspection, is apparent. The attention of the inspector in at once directed to the place where the waste is going on, and the time lost in indiscriminate inspection is saved.

The system was recently tested in Charlestown, the only section of the city to which it could be easily applied, and resulted in reducing the average daily consumption of 21,760 persons from 58.5 to 37.7 gallons per head, a saving of 20.8 gallons, or 35.6 per cent. per day for each person supplied, while the night rate was reduced from 37.5 to 15.8 gallons per head, a saving of 58 per cent. The total saving in the district amounted to 450,000 gallons per 24 hours, which, at two cents per hundred gallons, the price of water at meter-rates, represents an annual saving of $32,850.

There are, however, objections to adopting, in its entirety, either of the foregoing systems in Boston.

With the meter system there would be danger of reducing the consumption to a point below what is considered desirable for sanitary purposes. Again, it would cost more than a million and a half dollars to introduce the system, and a very large outlay would have to be made annually for repairs. Lastly, it is feared that, if the water was charged for at present meter-rates, the revenue would be reduced to an extent that would compel an increase in the price, and thereby injuriously affect manufacturing interests.

The system of indiscriminate house-to-house inspection fails to prevent waste from unsuitable fixtures, or from running water at night to prevent freezing. Besides it is objectionable to the careful person, whose fixtures are kept in repairs, and who naturally regards the constant visits of the inspector as an invasion of his domiciliary rights.

The objection to the immediate application of the waste-water meter system is its cost. Nearly all the stop-cocks in the service-pipes are located in the roadways, and are inaccessible except by removing the surface to the depth of a foot or more. The expense of changing the positions of the stop-cocks to the sidewalks would aggregate about $350,000. The saving that would be effected in the use of water in a series of years would, however, render even this large expenditure an economical measure, if there were no other methods by which the object could be accomplished.

It is believed, however, that a combination of the recording-meter system and the Deacon system, with house-to-house inspection, would work successfully in this city, and a plan has been considered, of which the following is a brief outline:

It is proposed to extend the use of the recording-meter gradually, as the Water Registrar may consider expedient, applying it only to manufacturing establishments and other places where large quantities of water are used and waste is suspected. These meters will be put on to determine and check waste, and will not be retained in use unless found to be necessary. The usual water-rates must be retained in order to raise the revenue required by law, except in cases where it may be found desirable to charge for the quantity of water consumed at meter-rates.

It is further proposed to divide the city into districts, as in the Deacon system. A waste-water meter will be placed on each district; and the consumption of water ascertained as a preliminary to beginning house-to-house inspection. A thorough inspection will then be instituted; all sources of waste will, of course, be discovered and remedied. At the same time the meter will be registering the consumption and will show the saving that is effected. Inspection being finished, and consumption reduced to what is considered a reasonable quantity, the meter will be left on the district for a time in order to detect any increase. If, after a few weeks, it is found that consumption does not increase, the meter will be removed to another district and the same process gone through with. In this way it will be possible to cover the whole city with a few meters, and without immediately expending a large sum of money for changing stop-cocks, etc. The result of each day's work can also be better ascertained, and the inspectors can be sure that their work has been thoroughly done in each district before passing to the next.

While this plan does not do away entirely with domiciliary visitation, the visits are made less frequent than would be the case if meters were not used; for, if after one inspection of a district, it is found that the consumption of water has been reduced to a proper point, inspection is discontinued and not renewed as long as it is kept at that point.

Twenty waste-water meters will be required to commence with. This will, of course, be only a beginning; but the work will proceed gradually, as the income will warrant, until the locations of all stop-cocks in the city are changed from the roadway to the sidewalks, and the Deacon system is adopted in its entirety.

The management of this part of the plan should be given to the City Engineer, in whose hands the experiment with the Deacon meter has already been so successful.

The expense of adopting the foregoing system is estimated as follows:

4,000 recording meters	$100,000
20 waste-water meters, and expense of connections	25,000
	$125,000

No system of preventing waste will yield entirely satisfactory results unless it includes a rigorous inspection of plumbing.

It is not sufficient that this inspection should be confined to an examination of fixtures that are out of repair; it must comprise the licensing of plumbers, an inspection of material, and a supervision of the work.

This necessity has been recognized in other cities, and stringent regulations have been adopted with most satisfactory results. Such regulations, properly enforced, not only prevent waste of water, but also protect the public from loss occasioned by bad plumbing, and, in the end, are an advantage to plumbers; for, if all are required to use the same quality materials, no one can have any advantage over another, and, if only first-class mechanics are licensed, sham workmen will be driven from the field. Another and more important aspect of the case is the relation which good and bad plumbing respectively bear to the public health. It is unnecessary to discuss the value of house sanitation, or the danger arising from badly constructed and improperly ventilated soil-pipes and water-closets. It is a matter of common knowledge that many of the zymotic diseases are traceable to these causes. An unskillful or incompetent person should not, therefore, be allowed to trifle with the health and lives of our citizens.

In Liverpool and other English cities the plumbing regulations are very stringent, comprising the inspection and approval of all fittings before use, and extending to the condemning and removal of all improper fixtures. In Lawrence, Mass., plumbing regulations were adopted last year. Builders are forbidden to cover in, or in any manner hide from view, any part of the plumbing-work of a house, until the same has been inspected and approved by the agent of the Board of Health. The agent is required to condemn and order the removal of any work that does not conform to the regulations. Washington, New York, Brooklyn and Providence enforce plumbing regulations, and all plumbers are required to be registered and licensed. In the three cities first named it is unlawful for an unregistered person to carry on the plumbing business. In all these cities the use of wasteful fixtures is discouraged by placing a high water-rate upon them. In New York, particularly, the rate is very high on the wasteful forms of water-closets, while the tax upon the double-valve cistern closet is only two dollars a year, as an inducement to substituting that fixture, which is in every way superior, on economic and sanitary grounds, to the old styles.

Several unsuccessful attempts have been made to enact regulations in this city.

The City Council was authorized, by chapter 105, acts of 1880, to prescribe rules and regulations for the inspection, materials, construction, alteration or use of all water-pipes and water-fixtures of every kind, but no regulations have been adopted. An act has been passed this year (chapter acts of 1882) giving the City Council authority to require the registration of plumbers, and to provide for the inspection of plumbing by the inspectors of buildings.

All the evils arising from bad plumbing could not be remedied in buildings already constructed without a more thorough overhauling of the work than would be practicable, but regulations can be made now that will be efficient in the future.

In conclusion, the committee submit the following recommendations:

First.—That a loan of $125,000 be authorized for the purchase of meters.

Second.—That the Water Board be authorized to expend $100,000 of that loan in purchasing recording-meters, to be applied to such places as may be recommended by the Water Registrar.

Third.—That the City Engineer be authorized to expend, under the direction of the Water Board, the remaining $25,000 in purchasing and attaching waste-water meters.

Fourth.—That the City Engineer, under the direction of the Water Board, be authorized to appoint, from time to time, such number of inspectors (not exceeding twenty) as may be required, and to carry on the proper inspection in connection with the waste-water meter, the expense to be charged to the revenue from Cochituate water.

Fifth.—That an ordinance, providing for the registration of plumbers and inspection of plumbing, be passed immediately.

The committee respectfully submit the following orders embodying their recommendations:

Ordered, That the City Treasurer be authorized to borrow, under the direction of the Committee on Finance, the sum of $125,000, the same to constitute a special appropriation for the purchase and attachment of water meters; $100,000, to be expended by the Water Board, in purchasing recording-meters, and $25,000, to be expended by the City Engineer, under the direction of the Water Board, in purchasing and attaching waste-water meters.

Ordered, That the City Engineer, under the direction of the Water Board, be authorized to appoint, from time to time, such number of inspectors as may be required, provided that the whole number appointed shall not exceed twenty; and to carry on the necessary inspection in connection with the waste-water meter, the expense to be charged to the revenue from Cochituate Water-works.

Ordered, That the Committee on Ordinances be requested to report an ordinance providing for the registration of plumbers and inspection of plumbing.

THE TAMARACK SWAMPS.—The "Tamarack swamps," near Sharpsville, Pa., were supposed to be an innocent sort of bog until the New York, Pennsylvania & Ohio Railroad Company undertook to lay a solid roadbed across them. At first a few thousand cubic yards of earth were dumped upon the surface by the contractor with careless curiosity, as much as if to say, "That will satisfy your appetite, my soft friend." But when the earth immediately disappeared and left no trace behind, a coarser diet was substituted. The company purchased from a furnace the accumulated cinders of 10 years, and since January about 5,000 car loads of this substantial provender have been dropped into the swamp's voracious maw without visibly decreasing its capacity. Occasionally at night there are evidences of repletion, but in the morning the murky water presents an unruffled face and asks for more. A solid roadbed could be laid close by, entirely avoiding the swamp, but the company has elevated its corporate back, and does not intend to be beaten by a miserable tamarack swamp as long as there is a dollar in the treasury.—*Exchange.*

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

Continued from page 179.

CCCXX.—FAIR HAVEN, VT.

Fair Haven, Vermont, in lat. 43° 37′ N., lon. 73° 16′ W., is on Castleton River, a small stream. Settled in 1779, it was incorporated in 1820 as a village.

Water-works were built in 1880 by the village, taking the supply from a lake of 80 acres' area, fed by springs and having a very small water-shed. It is 3.4 miles from the village and 200 ft. above it. The water is drawn from the lake through a tunnel in rock, 150 ft. long and 35 ft. below the summit of the high ground adjoining the lake. The water is conducted to the village by cast-iron pipes. The first 500 ft. is of 10-in. diameter, and then there are 3½ miles of 8-in. pipe. Distribution is by 5½ miles of 6, 4, 2 and 1-in. pipe, with 27 fire hydrants, 15 gates and 170 taps.

The population in 1880 was 2,211. The consumption is not given.

The works have cost $36,500, and the receipts have been $2,508. The bonded debt is $35,000, at 5 per cent. interest.

The expenses in 1881 were $594.53 and the receipts $1,558.88.

The works are managed by three commissioners, one being elected each year.

James Pottle is Chairman of the Board.

CCCXXI.—HANOVER, N. H.

Hanover, New Hampshire, in lat 43°42′ 15.3″ N., long. 72° 16′ 55.8″ W., is on a plain half a mile from and 125 to 175 ft. above the Connecticut River, and divided into two parts by a rocky ridge which rises at Observatory Hill to about 100 ft. above the plain. It is the site of Dartmouth College, and was settled under a charter granted July 4, 1761.

Water-works were built by a private company in 1821, taking the supply from springs near the foot of a steep wooded hillside, the soil of which is saturated with water. The company now controls 35 acres of this slope. The water is collected in five wells, 4 to 6 ft. diameter, and 8 to 12 ft. deep, lined with dry stone walls. From the lowest of these wells, 60 ft. above the village, it is conveyed to the village in a pipe 2 miles long. From 1821 to 1828, the pipe was bored pine logs. In 1829 this was replaced by a 1¼-in. lead pipe, and in 1880 this was replaced by a 2-in. lead pipe. From the well the pipe descends 60 ft. in the first 1,000 ft. to a brook, across which it is carried in a wooden box laid on the granite bed of the stream, and held down by boulders. Although seldom entirely submerged, the pipe has never frozen, even with the temperature of the air at 35° below zero F. The original pipe was badly aligned vertically, being laid following a very broken and undulating surface. The new pipe was laid on more regular grades.

Near the village it passes a hollow under a head of 110 ft. The pipe used is of the following weights: Under 60 ft. head or less, 7 lbs. per foot; under 60 to 80 ft. head, 8 lbs. and under 80 to 110 ft., 9 lbs. per foot. Distribution and service pipes are all of lead. There are no fire hydrants or gates. There are about 160 taps. The water is delivered to consumers through gauge butts of copper, perforated with a hole "of the size of a medium-sized sewing needle," which was intended to supply 40 gallons per day, but, with the new pipe, delivers so much more that it has been necessary to throttle the delivery at the well by closing the stop gate eight-tenths of its diameter.

The population in 1880 was 800. The consumption is about 6,500 gallons per day. The works have cost about $12,000. The capital stock of the company is $10,000. The cost of maintenance is very small. The receipts are about $950 per year, being six dollars for each "share" or quota of 40 gallons per day delivered.

The works are managed by the president, who receives a nominal compensation, and three directors, who serve without pay.

CCCXXII.—HANOVER, PA.

Hanover, Pennsylvania, in lat. 39° 47′ N., long. 77° W, is in an elevated valley on no water course.

Water-works were built in 1874 by a private company, after the plans of Robert K. Martin, C.E., taking the supply from mountain springs, the water of which is impounded by dams across ravines, in two reservoirs of 2,500,000 and 1,500,000 gallons capacity, 175 ft. above the town.

Distribution is by 6 miles of 8, 6 and 4-in. cast-iron pipe, with 26 fire hydrants, 9 gates and 253 taps. One meter is in use. The town pays $5 per year for each fire hydrant. Service pipes are reported to be of 1½-in. cast-iron pipe.

The population in 1880 was 2,317. The daily consumption is 30,000 gallons.

The capital stock of the company is $30,000. There is no debt. The works have cost $38,000.

The expenses in 1881 were $2,835.45, and the receipts $963.35.

S. Keefer is the President and General Manager, and R. M. Wirt, Secretary and Treasurer.

CCCXXIII.—SOMERVILLE, MASS.

Somerville, Massachusetts, in lat. 42° 23′ N., long. 71° 7′ W., is a suburb of Boston, on the Mystic River. The surface is undulating, rising from 10 ft. above low-water level to 120 ft. Originally a part of Charlestown, it was set off from that town in 1842, and was incorporated as a city in 1872.

In 1868 water was introduced from the Mystic Lake water-works of Charlestown, described in the account of the Boston works on p 142 of ENGINEERING NEWS, April 9, 1881. The Somerville works were constructed by the city after the plans of Roberdeau Buchanan. The Mystic works are owned by the city of Boston, the pumping station being, however, in Somerville, and the supply mains of 24-in. and 30-in. diameter passing through the city; the distribution pipes for Somerville are connected with them at fifteen different points. Distribution is by wrought-iron and cement pipes, of which 45½ miles were in use on May 1, 1881, with 288 fire hydrants, 392 gates and 1,227 taps. There are 31 meters in use. Service pipes of lead, of rubber-coated and of enameled iron are used.

The pipes are maintained by Somerville, but the water rates are collected by Boston, and out of them there is returned to Somerville a certain percentage, which in 1881 amounted to $14,687.37. The cost of maintenance in 1881 was $14,000. The city pays annually $20 for each 350 inhabitants.

The population in 1880 was 24,985. The consumption is not known.

The works have cost $342,608.76. There is a bonded debt of $335,000, at 5 and 6 per cent. interest. The works are managed by a Board elected annually by the City Council. The Board elects a superintendent annually. Nathaniel Dennett has been Superintendent since 1877. Work of construction is in charge of the City Engineer. This position has been held by George A. Kimball since 1876.

CCCXXIV.—PASSAIC.

Passaic, New Jersey, in lat. 40° 52′ N., lon. 74° 15′ W., is on the Passaic River, which is there dammed, affording a valuable water-power. The city is on ground, level near the river, but rising steeply from the plain to more than 100 ft. elevation.

It was settled in 1680. The Dundee Water-Power & Land Company, incorporated in 1872, caused a rapid increase of population. Water-works were built by the Acquanonck Water Company in 1872, after plans of Gen. Thomas D. Hoxsey, taking the supply from Vreeland Lake, a reservoir formed by impounding Weasel brook by a dam 40 ft. long and 12 ft. high, a mile from the village. To this supply, which is very limited, is added water from the river, which is lifted 125 ft. into a reservoir of one million gallons' capacity, by a pump driven by a turbine wheel and a supplementary steam engine.

Distribution is by 9½ miles of wrought-iron and cement pipe of from 12 to 4-in. diameter, with 83 fire hydrants, 13 gates and 250 taps.

The city pays $30 per year for each hydrant. Lead service pipes are used.

The population in 1880 was 7,000 and the daily consumption 500,000 gallons.

The capital stock of the company is $100,000. The works have cost $110,000. The amount of the bonded debt, which carries 6 per cent. interest, is not stated. No further financial statements are given. Washington Paulison is the Secretary, and T. D. Hoxsey the Superintendent and Engineer.

CCCXXV.—NEWCASTLE, PA.

Newcastle, Pennsylvania, in lat. 41° 2′ N., long. 80° 14′ W., at the junction of Shenango and Neshannock creeks, is on flat ground, surrounded by high hills.

Settled about 1800, it was incorporated as a borough in 1825 and as a city in 1869.

Water-works were built by a private company in 1881 after plans of James H. Harlow, C. E., taking the supply from Shenango Creek and pumping it by a Blake duplex pump into a reservoir built in excavation and embankment on a hill 2 miles north of the city. The reservoir contains 6,500,000 gallons at 266 ft. above the city. It is 150 by 188 ft. at the bottom, and 24 ft. deep. There is a berm 8 ft. wide at 14 ft. above the bottom. The bottom and slopes are covered with 2 ft. of puddle and above the berm the slopes are paved with dry stone on edge, 15 in. deep, on 9 in. of broken stone.

Distribution is by cast-iron pipe. The force and supply mains are of 12-in. diameter, and there are 12 miles of mains of from 10 to 4 in. diameter, with 95 fire hydrants, 60 gates and 88 taps. Two meters are in use. The city pays $5,000 per year for 100 fire hydrants and $40 per year for each one over 100. Lead service pipes are used. The population in 1880 was 10,292. The works being just finished, no statistics of consumption or finances are given.

L. H. Williams is Secretary and Treasurer of the Company, and John W. Taylor the Assistant Superintendent. J. H. Harlow is the Engineer and Superintendent.

CCCXXVI.—MISHAWAKA.

Mishawaka, Indiana, in lat. 41° 42′ N. long. 86° 12′ W., is on the St. Joseph River. It was settled about 1800 and incorporated as a town in 1836. Water-works for fire protection only were built in 1860 by the town, taking the supply from the river, which is here dammed for manufacturing purposes by a dam built in 1832, 300 ft. long and 8 ft. high.

A 16-in. Metzger rotary pump, driven by a Leffel turbine wheel, keeps the pipes constantly filled at a low pressure, which is increased in case of fire. There are 2 miles of cast-iron pipe of 8, 6 and 4-in. diameter, with 15 fire hydrants and 25 gates.

The population in 1880 was 3,500. The works have cost about $10,000, and the annual expense of maintenance is about $100. They are under the control of the Town Trustees. J. H. Whitson is the President.

CCCXXVII.—SALEM, N. C.

Salem, North Carolina, in lat. 36° 3′ N., long. 80° 14′ W., is on irregular ground, on the middle fork of Muddy Creek. Settled in 1760, it was incorporated in 1854. A water supply was first introduced about 1800, a force pump being used to fill the town cisterns. In 1878 water-works were built by a private company, taking the supply from two wells 10 ft. in diameter, sunk near the creek, and pumping by water-power 150 ft. into a brick reservoir holding 90,000 gallons at 50 ft. above the city.

Distribution is by 2 miles of cast-iron pipe, of from 8 to 2-in. diameter, with 20 fire hydrants and 65 taps. The town does not pay for hydrant service. Service pipes are of wrought iron, some plain and some zinc lined.

The population, in 1880, was 1,500. The consumption is not known.

The capital stock of the company is $8,000, which is the cost of the works. The receipts are $500 per year. L. N. Clinard is Secretary of the company, and C. A. Fogle the Superintendent.

(TO BE CONTINUED.)

ACKNOWLEDGMENTS.—The receipt of statistics as follows is acknowledged with thanks: From R. M. Wirt, secretary and treasurer, statistics of the water-works of Hanover, Pa. From James Pottle, chairman water commissioners, statistics and water rates of the water-works of Fair Haven, Vermont. From George R. Harlow, assistant engineer, statistics of the water-works of Newcastle, Penn. From G. A. Kimball, city engineer, statistics and water rates of the water-works of Somerville, Mass. From an unknown source, report of construction of works to May 1, 1880, at Peru, Ind. From Prof. R. Fletcher, Dartmouth College, statistics and water rates of the water-works of Hanover, N. H. From L. N. Clinard, secretary, statistics and water rates of the water-works of Salem, N. C. From J. H. Whitson, president, statistics of the water-works of Mishawaka, Ind. From W. Paulison, secretary Acquackanonck Water Co., statistics of the water-works of Passaic, N. J. From William H. Vibbard, sanitary engineer, annual reports of village of Kalamazoo, Mich, 1882. From M. Scannell, superintendent, water rates of the water-works of Tiffin, Ohio.

CORRECTION.—June 3, 1882, p. 179, *Lockhaven*. The lightning struck a *house*, not a *horse*.

A SINGLE MERIDIAN.

At the recent International Geographical Congress held at Venice, a resolution was adopted at the instance of the American delegates asking for the appointment of an international commission, to consist of three members, to be appointed by the different governments, from geologists, geographers and men interested in commerce, "to consider the question of an initial meridian, having in view not only the question of longitude, but that of hours and dates." The reform thus contemplated is one which should receive the hearty support of our own and other governments. It is high time that a single meridian should be in use by all the civilized nations, instead of England using the meridian of Greenwich, the Germans using that of the Island of Ferro, the French that of Paris, the Spaniards that of Madrid, and America using the meridian at Washington. Much confusion would be avoided by uniting on a single meridian, while there would be a great saving in operations which are now necessary in making reductions from observations taken with reference to one meridian, so as to be comparable with observations taken in reference to another. Unification is the day, and let us have full unity on the meridian question.—*U. S. Econ.*

ENGINEERING NEWS
AND
AMERICAN CONTRACT JOURNAL.

Tribune Building, New York City.

GEO. H. FROST.....EDITOR AND PROPRIETOR.
JULIUS W. ADAMS,* Past President A. S. C. E., } ASSOCIATE EDITORS.
S. D. V. BURR..... }

SATURDAY, JUNE 10, 1882.

EDITORIAL ANNOUNCEMENTS.

***Communications** for Mr. Adams should be addressed to Julius W. Adams, care of this journal, New York city. Articles written by Mr. Adams will be signed thus *; and only for articles so signed will he be responsible.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months, $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CONTENTS.

	Page.		Page.
The Waste of Water	187	EDITORIAL DEPARTMENT:	
The History and Statistics of American Water-Works	189	Secondary Batteries	193
EDITORIAL DEPARTMENT:		The Durham System of House Drainage	194
Concerning Water Meters	190	Personal	194
Obstructions to River Discharge by Bridge Piers (*Illustrated*)	190	Engineers and Engineering in Other Lands	194
		CORRESPONDENCE:	
		Correction	195
		General Intelligence	195

CONCERNING WATER METERS.

The growing importance of the subject of waste of water in our large cities is evidenced by the carefully prepared report of the Boston Water Committee, which we publish elsewhere this week. Chief Engineer Whitman, of St. Louis, has also presented a vast array of facts on the subject to the government of that city. The engineers of other important American cities have also urged the importance of the subject, and we think it may fairly be conceded that the time is close at hand when other means than the indefinite and expensive extension of water-works will be resorted to, to insure an abundant and never-failing supply of water for all purposes, domestic and manufacturing, which our ever and rapidly increasing population and trade demand.

The cities on the great lakes, Chicago, Cleveland and Milwaukee, pumping from their great storage reservoirs, were disposed to be excessively liberal in their supply of the necessary fluid. But Chicago, with all its immense pumping facilities, cannot keep pace with the wasteful habits of its citizens, and new engines are now in process of erection, which, in a comparatively few years, will have to be added to in all probability. So it is in other large cities; bad plumbing and reckless waste are adding daily to the burdens of taxation in all cities having a public water supply, without receiving anything like an equivalent as regards improved sanitation. What this extra taxation amounts to may be computed from obtainable data as to the cost of water-works extension and their yearly maintenance. In this city an immense sum of money will soon have to be expended for an increased supply of water. We presume that if the waste were decreased seventy-five per cent. that the present facilities are sufficient for many years to come, and the same might be urged of other cities.

The Boston plan is to do whatever is undertaken in a thoroughly efficient manner. The time is so recent when a swarm of engineers and contractors were at work on an additional water supply for the city that was to be abundant for a long time to come, that a reported scarcity might well awaken a desire to try some other remedy than still other extensions. Under the direction of Superintendent Jones, of the Boston Water Department, extensive and elaborate experiments on meters for measuring water and for preventing its waste have been in progress for several months past. Last week we spent a couple of days in Boston visiting the improved sewerage works at Dorchester and Moon Island, and in witnessing the meter tests at the City Machine Shops, conducted by Mr. Dexter Brackett, Asst. City Engineer. These tests were for endurance, a stream of water under extra pressure being turned on and allowed to run till the meter gave out, thus testing the comparative strength of each style of meter. Tests for accuracy of measurement were made previously and at another station. The results of these experiments have been embodied in a paper which will soon be published in the Journal of the Engineering Association, and which is for sale by H. G. Prout, 12 Barclay street, New York. It will be illustrated with diagrams and cannot fail to be of value to all parties interested in this subject. But in conversation with a manufacturer of meters, he remarked of this testing for endurance that the best test was actual use, in which the meters were subjected to the wear and tear of large streams and small streams, high pressure and low pressure, sudden or slow shutting off, changes of temperature, etc., etc., that are the daily circumstances in the life of meters. While, therefore, Mr. Brackett's experiments may demonstrate the comparative strength of competing selected meters of different manufacturers, they cannot be considered as conclusive as against the unsuccessful ones.

We were interested in looking over the array of meters sent in for the test and not a little surprised to learn of the many different manufacturers. Upon inquiry and from personal knowledge we now know of the following manufacturers of water meters: H. R. Worthington, Union Water Meter Co., National Meter Co., Eagle Water Meter Co., Tilden Water Meter Co., Continental Water Meter Co., Desper & Co., Howe Water Meter Co., Spooner-Diaphragm Water Meter Co., United States Water Meter Co., Standard Water Meter Co., New England Water Meter Co.; we believe these are all we *now* know of, but we will be obliged for any additions to the list that may be sent us. Some of the above list are apparently mere stock jobbing schemes to wheedle the loose change of gullible investors into the hands of impecunious but wily sharpers; two of them we had to sue for our advertising bills but failed to collect even then; of a more recent concern that has a "small" supply of shares to dispose of we could find no record in the Boston Directory, the Boston Water Department had never seen even a sample meter, the President of the Company, whose name the meter bears, has been for some time in Wiscasset, Me., and doesn't know "anything about the finances of the Company." So far as we could learn the "Secretary" is a clerk in a shoe store, and the "Superintendent" was always out of the "N. Y. office" when our solicitor was in that vicinity. How the name of the wealthiest New York merchant came to be used as a card we have yet to learn. But we have amplified on this subject because we have made personal investigation on the subject of meter manufacturers, the result of which is that we find from our own inquiries and observations and from the "History and Statistics of American Water-Works," compiled by Mr. Croes that, with the exception of a few Desper meters and a few made by the New England Meter Co. of Boston, that the only meters in general use are those made by H. R. WORTHINGTON and the NATIONAL METER CO., of New York, and by the UNION WATER METER CO., of Worcester, Mass. These companies actually make meters and the *best* meters that are now in use; they do not peddle shares of stock for subsistence; they have large shops which we visited and found full of men and machinery, and all working up to their fullest capacity; their goods are known wherever there is a water supply of any considerable extent, and, with the increasing demand for meters, it is to *these three* companies that water commissioners look for their supplies. We regret very much that we were induced by our imaginative and sanguine advertising solicitors to admit certain meter stock schemes to the respectable fellowship of the above companies, and water companies may rest assured that the next meter makers that are advertised in this journal will have something more than a printed prospectus and an electrotype to found their claims to our consideration upon. We will be pleased to publish at any time the name of any *bona fide* meter company, the location of their shops, the number of men they employ, and the list of water-works using their goods. We make exception of the three firms we have already specified, as they are already too well known to need such indorsement.

OBSTRUCTIONS TO RIVER DISCHARGE BY BRIDGE PIERS.

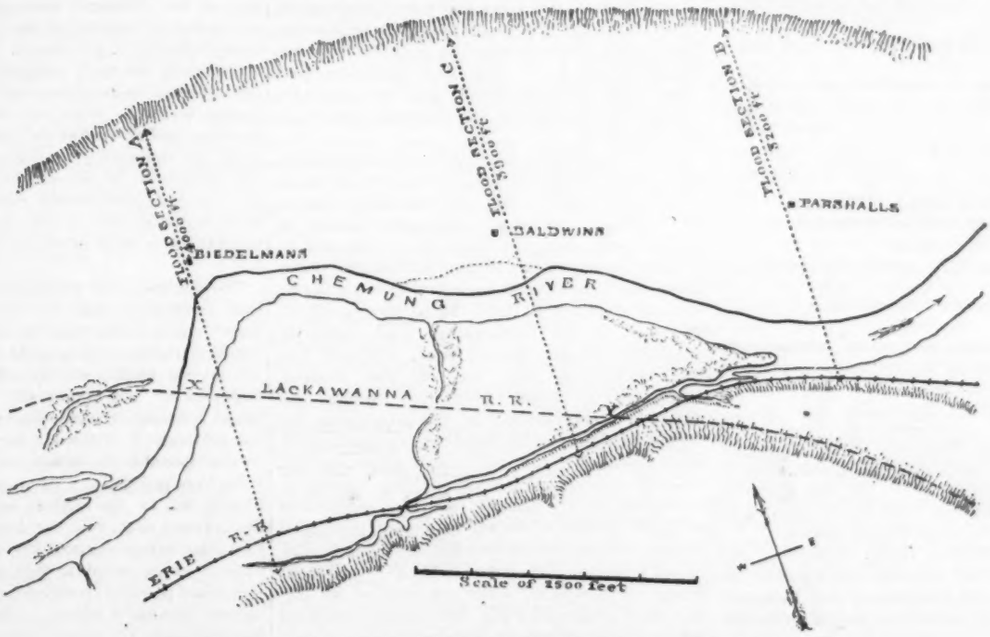
BY GEN. Q. A. GILMORE, U. S. ENGS. VAN NOSTRAND: JUNE, 1882.

We propose to review the above paper as involving a question of some moment to hydraulic engineers, and as we have a personal knowledge of the case, will add such comments of our own as we think are called for. We regret that space will not permit more than brief quotations from the paper, or scarcely more than results, omitting, necessarily, much of the argument upon which the writer founded his selection of formula.

In 1881 the question of crossing the line of the New York, Lake Erie & Western Railroad (referred to in these papers as the Erie Railroad) by the line of the New York, Lackawanna & Western Railway (known as the Lackawanna) then under construction through the town of Chemung, Chemung County, N. Y., came before a commission at Elmira, N. Y.

The place selected for the crossing by the Lackawanna Co. is about 10 miles east of Elmira. At this point, and for some miles west of it, the Erie Railway skirts the base of the hills on the south side of the Chemung River valley, while to the eastward its track leaves the high ground and traverses the bottom lands for a distance of about 8 miles and then crosses to the north side of the Chemung River. The entire width of the valley, including the flats on both sides subject to overflow in the times of flood, varies from ½ to ¾ of a mile, and within this width the river, while pursuing its southeasterly course toward the Susquehanna, of which it is a tributary, meanders from side to side in the manner usual with streams flowing through alluvial lands. The bed of the stream, as defined by its banks at ordinary stages, has a width ranging from 400 to 500 ft., and the banks themselves are 10 to 14 ft. in height above the ordinary low river stage. The surface of the bottom lands is somewhat undulating and irregular, so that a flood rise of 20 ft. above extreme low river overflows them to a depth ranging from 4 to 10 ft., the average depth being not more than 5½ ft. With a flow of this height, the width of the river at Baldwin's (section C of plan), near the point where the railways cross each other, is 3,900 ft. Half a mile below this point to the eastward at Parshall's, the flow width was 3,200 ft., and half a mile to the westward at Briedelman's (section A) it was about 4,000 ft., but on this westerly section the highway near the ordinary river bank on the north side is not put under water by a 20-ft. rise, although the bottom land between it and the high ground to the north was submerged to the depth of 6 ft. in some places. The av

erage of the widths of these three sections is $\frac{4,000 + 3,900 + 3,200}{3} = 3,700$ ft, and may be assumed as the mean width of the stream on a 20-ft. rise for about one mile in length above Parshall's. This was the height of the flow of 1865, and which maintained its level for some hours, and submerged the Erie track to the depth of the floor of a hand car, and caused an entire suspension of the traffic on that part of the road. This was in evidence. The river at this point drains about 3,000 square miles, and at ordinary low stage of water is an insignificant stream, consisting of a succession of ripples and slackwater pools, the general slope as ascertained by precise levels at this stage being over 4 ft. to the mile. The depths in the pools vary from 4 to 10 ft. The discharges at low stage possibly not over 2,000 cu. ft. per second, if so much.



OBSTRUCTIONS TO RIVER DISCHARGE BY BRIDGE PIERS.

A narrow branch of the river, or slough, known as Parshall's Cove, about as deep as the main stream, runs in close proximity, and nearly parallel to the tracks of the Erie Railway at the point of crossing of the roads, and to the east and west of it for a distance of three-fourths of a mile, thus separating it from the bottom lands. During the flood stage, when the flats are under water, this slough runs with a high velocity, and discharges a comparatively large volume of water; but ordinarily the only connection of the cove with the river is from below.

The Lackawanna road, approaching from the east as projected, crosses the Erie road above grade at an acute angle of 22°, then crosses Parshall's Cove at the same angle, on a bridge of three spans of 150 ft. each (Y on plan) measured parallel to the track, giving an effective opening of only 180 ft. at right angles, to the axis of the cove, then crosses the bottom lands diagonally on a solid embankment for a distance of about 3,300 ft., to the right branch of the Chemung River, crossing that river at an angle of about 78°, with the direction of its branch, on a bridge of four spans of 150 ft. each X on plan) or an effective opening to the current of 576 ft. From the abutment on the left bank the road as projected continues on a solid embankment to the high ground on the north side of the valley.

Accepting 3,700 ft. as the average width at the flood stage of the three sections at right angles to the flood current (viz., A, C and B of plan), it will be seen that the Lackawanna road as projected leaves an effective opening in the embankment across the valley, from the high land on the north side to the high land on the south, of 756 ft., thus reducing the width of the high river waterway nearly 80 per cent.; that is, the obstruction, consisting of embankment and bridge piers and abutments, would amount to nearly *four-fifths* of the entire width in a flood like that of 1865. The effective water-way, however, would not be obstructed in so great a proportion, because the bridge openings are located in the deepest water. The mean area of the three flood sections being 31,538 sq. ft., and the flood areas under the bridges taken on sections at right angles to the current being 13,068 sq. ft., the effective waterway for a 20 ft. rise, like that of 1865, would be, obstructed 58.6 per cent. by the Lackawanna road.

The Erie road opposed the location and method of construction adopted by the Lackawanna road for crossing the valley, on the ground that so serious an obstruction to the passage of the floods would cause an increased rise or backing up of the water to such a degree that the destructive effects of the higher floods would be greatly increased, while those of ordinary magnitude, which would otherwise be harmless, might thereby be rendered dangerous and destructive. It was also claimed that there would be danger from ice gorges and that the funnel-shaped opening between the two roads above their intersection, with its base pointing up stream, rendered the accumulation of ice and the formation of an ice gorge at the cove bridge (Y of plan) highly probable.

There had been no observation taken during the freshet of velocity of current, or indeed any observations of a scientific character, and after a lapse of 16 years the only data for computation of discharge would be derived from the levels of such marks as remained legible, indicating the surface levels of the freshet, together with the evidence of the proprietors or occupants of the land who were cognizant of the circumstances. Gen. Gilmore gives the data upon which his estimates were founded as follows:

The difference of level between the flow mark at Parshall's and Baldwin's (section B and C of plan) was 1.73 ft. or 3.806 ft. per mile=.0007208. This was on the flat where the water was shallow. The slope could not have been less than this in the main stream. On the contrary, it would naturally be expected that the flood slope would be at least as steep as that of low river, *which is four feet to the mile*, and certainly as steep as that of the overflowed bottom lands of the valley on the line of the general axis of the flood current, *which is known to be more than four feet to the mile*. The section or profile at Parshall's gives a water way of 3,200 ft. and an area of discharge of 24,235 sq. ft., for which a slope of 3.806 is taken, although, as he says, this slope is strictly applicable to the distance between Parshall's and Baldwin's, a distance of 2,400 ft. This profile he divides into two compartments—a deep one embracing the bed of the Chemung River, and a shallow one covering the flats inundated by the flood. The following is his statement:

	Width.	Area.	Hyd. rad.
Deep compartment.....	500 ft.	10,752 sq. ft.	21.504 ft.
Shallow compartment.	2,700 "	13,483 "	4.9937 "
Total.....	3,200 ft.	24,235 sq. ft.	.....

Surface slope=.0007208.

To obtain the mean velocity of the sections, he selects from the various formulæ presented (all of which require as factors the surface water slope, and either directly or indirectly the hydraulic radius), the one which is the most simple, where v, the mean velocity in feet per second, is represented by a coefficient into

$$\sqrt{R.S}, \text{ or } v = C \times \sqrt{R.S},$$

and he assumes for C in the deep compartment a value of 100 from Downing, and according to Young, 84.3 for the value of C in the shallow compartment on the flats, which gives the following result:

	Mean velocity.	Volume of discharge.
Deep compartment.....	12.45 ft.	133,865 cu. ft.
Shallow compartment.....	5.0577 "	68,194 " "
Total.....		202,059 cu. ft.

Mean velocity $= \frac{202,059}{24,235} = 8.3$ ft. per second.

Gen. Gilmore remarks with reference to this apparently large discharge, equalling as it does during a 20-foot rise more than one-fifth of the discharge of the Mississippi; that at the time of the freshet the ground was frozen and covered with deep snow and a sudden thaw set in, accompanied by a heavy fall of rain, the stream exhibiting at such times a *not very mild type of mountain torrent*, and although the flood section of the Chemung is only about one-eighth of that of the Mississippi, its surface slope, on which the velocity and therefore the volume of discharge directly and largely depends, is about *thirty-five times as great*. Estimating the flow of the stream during each of the four hours when at its maximum height as amounting to $\frac{1}{100}$ of an inch in depth over the entire shed, there is no difficulty in accounting

for the estimated discharge of 202,000 cu. ft. per second.

The vexed question of velocity upon which experimenters differ so much, is gone into by Gen. Gilmore with some detail, and reference is made to the investigations of Hagen, Darcy, Bazin, Humphreys, Abbott and Kutter, all of whom differ very materially. Bazin's formula giving in the present case a discharge of 197,673 cu. ft., and Kutter's 161,000 cu. ft. per second for a 20-ft rise.

Coming to the end and object of these investigations, viz, the backing up of such a flood, occasioned by the artificial obstructions caused by the Lackawanna Railroad, Gen. Gilmore assumes that for the purposes of this computation these constructions were located at right angles to the axis of the valley, with a clear opening at the bridges of 756 ft. This imaginary profile at flood being 31,538 sq. ft., and dividing the discharge of 202,059 by it, gives the mean velocity as 6.4 ft. per second; and hyd. rad. of the entire section being $\frac{31538}{3700}$ = 8.5238 ft., and the hyd. rad. at both bridges being the areas 13,068 divided by effective width, 756 ft. = 17.285, then using Eytelwein's formula of $y = \frac{v^2}{m^2}\left\{\frac{W^2 \times h^2}{w^2(h+y)^2} - 1\right\}$

where

y = increased head or backing up,
W = original width of profile in feet,
w = reduced width of " " "
h = original mean depth of profile in feet,
$\frac{1}{m^2}$ = co-efficient for contraction

he finds y=2.4272 ft., as the rise occasioned by such a flood, or by using the formula given by Debauve *Manuel de l'Engenieur des Ponts et Chaussées* of $y = \frac{Q^2}{2g}\left\{\frac{1}{m^2 w^2 h^2} - \frac{1}{W^2(h+y)^2}\right\}$ with the same notation as above, except, taking the co-efficient of contraction m = .90, and Q equals volume of discharge in cubic feet per second, he obtain y = 4.3168 ft. as the increased head.

Taking the formulæ of Bazin, Humphrey and Abbott and Kutter for velocity, and applying the respective results to Eytelwein's and Debaure's formula for rise, the whole are shown in the following table:

Formulæ for Velocity.	Volume of discharge c.ft.p'r sec.	Formulæ for rise.	
		Eytelwein.	Debaure.
		Feet.	Feet.
D'Aubuisson & Downing.	202,059	2.4272	4.3168
Bazin.	197,673	2.3474	4.1113
Humphrey & Abbot.....	131,573	1.2092	1.7587
Ganguillet & Kutter.....	161,010	1.6908	2.6775

In arriving at the results of the above tabular statement, Gen. Gilmore has specified minutely the locality of the cross-section which he uses in his calculations, as also the data furnished him in reference to the flood-marks of 1865, and likewise the various hydraulic formulæ which engineers have hitherto regarded as applicable to such calculations, and has given also his application of this data to the various formula at each and every step, with a thoroughness much to be desired in the case of disputed authorities; and his personal experience in the behavior of great rivers in flood, having been for years on the Mississippi River Commission, entitle his opinions to great weight in the premises. It will be observed that he estimates the rise in such a flood, occasioned by the given obstacles, as from 1.2 ft. to 4.3 ft., according to the authority which may be accepted as applicable to the case, the data at his command being the flood section and the surface slope. The results obtained by him were combated by the expert upon the part of the Lackawanna road, upon the ground that the topographical features of the locality combine to render utterly unreliable any attempt to ascertain the discharge by computation from cross-section and slope.

One of the experts called in the case, using D'Aubuisson's formula of $v = 94.7\sqrt{RS} - 0.11$, made the discharge to be 169,441 cu. ft. per. second, which he considered too large, and then considering the highest known flow of the Merrimac River to have delivered but ¾ of an inch in twenty-four hours over the entire shed, and computing the delivery from the Chemung shed of 2,770 square miles to be at the same rate, it would give but 55,860 cu. ft. per second; and regarding this as too low, and having no better guide, took an average of the two, or 112,652 cu. ft. per second, as the discharge of the Chemung in the freshet of 1865.

Not being in possession of the characteristics of the Merrimac, we will show, by reference to the Connecticut, how far the discharge of one river may be taken as a certain guide for another without reference to their respective peculiarities. The report of General Ellis, made to the United States Government, of his gauging of the Connecticut River for some years, shows a water-shed of over 10,000 square miles, and a flood discharge of 212,000 cu. ft. per second. The flood slope of this river for 36 miles above Hartford to Holyoke Falls was at the rate of 1.1 ft. per mile, while the flood slope of the Chemung river of little less section for the same distance above the proposed crossing, is 4 ft. per mile!

This fact, as also Gen. Gilmore's supposition, given above, of the discharge from the Chemung water-shed, under the circumstances named, of $\frac{1}{10}$ inch per hour for the maximum duration of the flow, will show the value to be attached to such loose comparisons of river discharges. After citing the Potomac and Kanawha river discharges without reference to their slopes, the expert on the part of the Lackawanna road, from the discharge of the rivers cited, claimed that the valley at the site of the crossing was not a proper place to furnish the data for a computation of discharge—that the varying direction of the main river channel, which carried nearly half the entire flow, winding through, crossing and recrossing a valley whose general direction was nearly straight, its banks fringed with trees, the surface of the valley (a plain) obstructed by masses of woods and detached trees, and to some extent by houses, fences and the like—would so far hinder the flow of the water and increase its surface slope as to render any computation valueless which was based upon measurements made at that place. He accordingly goes some ten miles up stream, and selects the bridge crossings at Elmira, of which there are three of varying lengths, and a mill dam, all within a distance on the river of little over half a mile, and condemning the Downing-d'Aubuisson formula, "as incapable of correctly representing the flow of water in open channels, and its results as not worthy of confidence," proposes to make up for the paucity of data in his possession, by a little more intricacy of formula, and claims for the Kutter formula

$$v = \left\{\frac{41.6 + \frac{1.1811}{n} + \frac{.00281}{S}}{1 + \left(41.6 + \frac{.00281}{S}\right)\frac{n}{\sqrt{R}}}\right\}\sqrt{RS}$$

all attainable accuracy.

This formula has a decided look of precision about it, but we submit, with all due deference to better judgment, that no more than any other formula will it insure correct results from insufficient or loose data.

We are not in possession of the notes or data used by this expert on the part of the Lackawanna road at Elmira—whether he used one bridge or all three—or the slope resulting from the combined obstacles of the locality, or finally, what was the degree of roughness allowed in the Kutter formula for the bed, but the resulting discharge of the river at that locality was given as 72,815 cu. ft. per second.

It seems with all this care to introduce an accurate formula, a simpler one might have served the purpose as well, for it appeared subsequently that the entire flow did not pass through these bridges, but overflowed the banks above and broke through the railroad bank, and ran down in another channel. It was therefore not included in the computed discharge above stated, nor was there any obvious way to measure it. It was finally estimated by some common sense process without recourse to Kutter, as amounting to 6,105.13 cu. ft. per second, and adding it to the 72,815, and increasing the total in the ratio of the drainage area at the crossing ten miles below, to the drainage area above Elmira (the character of the respective mountain torrents intervening between the localities being wholly ignored), a total discharge of 91,547 cu. ft. per second was claimed as the probable maximum discharge of the flood of 1865 at the Chemung crossing, *ten miles to the eastward*. Subsequently, on rebuttal, it was proved that there was still another escape of freshet water at Elmira, which had been neglected in making the above estimate, and, failing any other method of estimating it, the quantity was computed by the formula for the discharge of weirs, and increasing this again in the ratio of the drainage areas, gave 3,500 cub. ft. per second to be added to the above, making the total 95,000 cu. ft. per second.

Having by this truly scientific method overcome the objection to using sectional area of flood discharge and slope of surface at the point in controversy, and arrived at the discharge at the latter point by estimating it elsewhere, and guessing at the margin to be allowed for a change in longitude, he computed the rise occasioned by such a flood as that of 1865, or with 58 per cent. of the natural water way obstructed, as but .568 of a foot!

The endeavor was made to prove before—or by this commission, that the acknowledged rise of water, which at the point of controversy had laid the Erie railway track some 2 ft. under water for several hours, was occasioned by the *wave* produced by the giving way of the State dam above Corning 28 miles distant; and as the dam was no longer in existence, no such effect was to be anticipated in the future, and hence no precautions were called for. The evidence was so conflicting as to the extent of the breach in the Corning dam, and the length of time which took place before the pool above this dam had subsided a given amount, that no definite conclusion could possibly be arrived at, as to wave effects thereby produced below. The pool above the dam was some 470 acres in area, and the witnesses to the break of the dam, on one side, averred that the water in the pool above fell 4 feet in about 1¾ hours, and on the other side they were equally positive that the breach in the embankment was only 10 or 12 ft. wide; that the dam was drowned out, the water on both sides being about level with the top of the guard bank; that the water in the pool above did not fall after the break, but was somewhat higher later in the day. Let this be as it may; as the water remained at its maximum height 28 miles below for *several hours*, there could have been no movement of the water at that point in a river of these dimensions at all analogous to a *wave;* and the facts stated in support of the wave theory, that in the artificial navigation of the river Yonne in France, impounded water starting with a height of 3 ft. was 2 ft. high at the junction of the Yonne with the Seine, and one foot high at Paris, 60 miles below, gives no support whatever to this wave theory at Chemung, as there was no comparison in the width of river, the surface slope, the depth or duration of maximum height in the two cases, although it was considered on one side as establishing the *probability* that the wave increased the height of the water at Chemung about one foot.

In the official decision of the Commission in this case, the statement is made that the expert on the part of the Lackawanna road, in addition to his computation of the discharge of the river at Elmira, also made a computation by using a section or sections near the point of crossing, by which the volume of discharge was estimated at 99,000 cu. ft. per second, approximately, but the language is so obscure that we are unable to define precisely what sections these were or any of the data used in the computation,

and are, in consequence, confined to the simple statement of the result. The Commission then give their decision, from which we quote as follows: "That the volume of discharge was about 100,000 cu. ft. per second, and after making all allowance for the excess of that flood over all other known floods, *and for the effect of the break in the Corning dam during that flood of* 1865, they determined," briefly and with reference to this hydraulic question, that an opening shall be made in the bank west of the Chemung River bridge, and immediately adjoining it, of not less than three spans of 184 ft. each in the direction of the flood current, or 405 ft. additional opening.

What was the calculated rise of backwater which this additional opening or water way through the embankment, equivalent to 8,100 sq. ft. would reduce to zero, is not stated by the Commission, and it would be idle for us to attempt the solution with so wide differences as those assumed for the data of the calculations of the several experts.

We do not think this Commission has settled any contested principles or practices of engineers in the computation of flow of water in open channels. Great stress was laid upon the inapplicability of the hydraulic formula in general use until within a very few years, and it was claimed that the Kutter formula alone was worthy of any confidence. It is undoubtedly a valuable contribution to our stock of hydraulic formula, and we would not attempt to weaken confidence in its use, but, like all other formula of like purport, it must be used with discretion, and with some reference to the experiments upon which it was founded. In the present case, here was a stream that ordinarily carried less than a couple of thousand cubic feet of water, suddenly called upon to discharge nearly, if not quite, a hundred times as much. No one will pretend to say that the Kutter formula had been built up by any such experience or observations; and in searching for a formula expressive of the governing circumstances of the case—simplicity would be first requisite, coupled with a recognition of the broad principles which philosophers and engineers for the last hundred years have borne testimony to as underlying the whole subject. We allude to the law of falling bodies, the accelerating force of gravity on an inclination, and the retarding effect of the wetted perimeter, qualified by the greater or less volume carried in the section. This, combined with a factor expressive of the frictional resistance of the channel and deduced from experiment, is the expression from which, by reduction, we derive the simple formula of the mean velocity equaling the square root of the mean hyd. radius, and the mean hydraulic slope, *multiplied by a variable coefficient*, or

$$v = \sqrt{RS}$$

A writer in "Engineering,"* taking the different authorities for the use of this formula, shows the following values adopted by them for the coefficient.

Young, for large streams	c =	84.3
Neville river velocity, < 1. 5 ft.	c =	92.3
" " " > 1. 5 ft.	c =	93.3
Eytelwein, generally	c =	93.4
Beardmore, open channels	c =	94.2
Stevenson, for streams of 30 c. ft.	c =	69.0
" " rivers 2,500 c. ft.	c =	96.6
Leslie, small streams	c =	68.0
Downing, Taylor, D'Aubuisson, for open channels.	c =	100.0

and comparing the results of the above formula with known discharges, he states that the coefficient of 100 gave *too small* results in cases where the areas exceeded 7,000 sq. ft. with a mean velocity of 2.5, or a discharge of 17,500 cu. ft. per second, and too large results for cases of smaller section. That the Eytelwein coefficent, 93.4, in the same way is too small above and too large below, a discharge of about 2,000 cu. ft. per second; and the Young coefficient, 84.3, is incorrect for everything above 900 cu. ft. per second; also, that for small streams of 25 cu. ft. a coefficient of about 60 is tolerably accurate, and adds: "It is evident then that with a large number of cases of carefully measured discharge, this principle of determining practical coefficients, in relation to approximate volume or velocity, might be carried out to further exactness, and it is very desirable that this should be done."

Special argument in support of the value of Kutter's formula for all cases of open channels, having in view as a factor, and introducing into the coefficient c. an expression for the roughness of the bed of the stream, will be found in a forthcoming number of the Transactions of the A. S. C. Eng., and which should have found place here with the review of Gen. Gilmore's paper as part of the proceedings before the same Commission, and of general interest in that connection, but it would have anticipated the publication of the former paper in the Transactions of the Society to which it was addressed, and through which alone it can properly reach the public. When it appears, a complete answer and refutation of the claim of the Kutter formula to *universality of application* in its present shape will be given in the republication from the Transactions of this same Society, of a paper by Gen. Theo. G. Ellis, of Hartford, who has made the subject of the flow of large rivers a special study for several years past in the service of the U. S. government, under circumstances giving great advantages for the elaboration of sound theoretical as well as practical views.

* Van Nostrand's Magazine, 1873, p. 320, article, Hydrodynamic Formulæ.

SECONDARY BATTERIES.

Long ago it was observed that if the current from a pile was passed through a voltameter—two platinum points immersed in a jar of acidulated water—a decomposition of the water resulted, depending in its violence on the strength of the current. If this circuit was broken, and the two wires leading from the voltameter joined to a detector, or galvanometer, a deflection took place showing that there was a reactionary movement in the voltameter itself. Later experiments were made to show that this secondary current moved in a direction contrary to that of the exciting current. Almost any elements, placed in a proper conducting medium, will yield a secondary current after having been subjected to the influence of a battery. Up to the present time lead in dilute sulphuric acid has been found to produce the most satisfactory results, and it is our object in the following remarks to examine the causes which produce the second current and also to see if the factors of loss are so great as to seriously interfere with the practical application of the apparatus.

In no sense whatever is the secondary battery an accumulating or storing battery of electricity—electricity has not yet been bottled, and never will be unless it happens at the same time that all motion is caught and caged. We know that the appelations were first used figuratively, nevertheless they should be expunged. So far as the subject is known at present electricity seems to be a motion of the atoms constituting the medium through which it acts, and is itself created by a motion which may be mechanical as in the dynamo or the outcome of chemical action as in the pile.

Another fact in regard to electricity is what has been aptly termed its "interchangeableness." By power we move a dynamo and generate a current; by sending a current through a dynamo we obtain a motion convertible into power. Atomic motion in a battery produces a current; conversely a current produces decomposition. In the first instance the greater the amount of power expended the greater will be the result; the same is true of the next, the more intense the chemical affinities the greater will be the effect.

In the Faure secondary battery the exciting current produces a decomposition or change in the lead elements which will result in a recomposition upon its cessation. The plates are covered with an oxide of lead, and immersed in dilute sulphuric acid. No chemical affinity being present, there is no action, and it now becomes the duty of the electric current while passing through the battery to so change the elements that there will, upon its stoppage, be such a chemical action as will produce the secondary current. The oxide of lead manually placed on the plates and held in position by coverings of parchment undergoes a change: that on one element becomes a peroxide, while the oxygen from the other leaves it, and the spongy mass of lead is the result. We now have in the battery after the action has ceased two elements immersed in a suitable medium, which have a strong chemical affinity for one another. From this point the action of the battery is essentially the same as that in any chemical pile; oxygen from the peroxide element is liberated; the reduced lead is recomposed and becomes the oxide just destroyed, the result being the redeveloping of a portion of the current of electricity which was required to produce the change.

In this, as in any battery, the strength of the current and its duration depend upon the violence of the chemical action and the superficial area of the elements. Also, as in other cases, if a rest be allowed after the current has weakened from continuous action, a large percentage of the strength of the first current will be perceptible in the second. This is for precisely the same reason as the recovery in the ordinary battery.

The commercial success of batteries constructed upon this principle will depend upon the cost of manufacture, size and economy. The cost of manufacture is comparatively small, and as the destruction of material is also small, the question may be omitted at present. The size is a great drawback, and until it is reduced most considerably it is not probable that secondary batteries will be located in residences and taken in wagons daily to a central station to be "charged." The actual cost of running is the most important factor in the problem, and as the steam engine may be taken as the generator, the question will be, ultimately: How much electricity can be obtained by the consumption of one pound of coal? As the losses from the method of burning the coal, from the engine and from the dynamo are the same for the secondary battery as for the dynamo current direct, we will only consider the loss occasioned by the use of the battery.

It is a well-known, though often disregarded law, that the nearer the work can be done to the generating power the greater will be the effect obtained. The nearer coal can be burned to the pit's mouth the less will be the cost of manufacture; the nearer a lathe can be run to the engine the smaller will be the cost of running that lathe. Every additional operation, every moment of time and every foot of distance intervening between the cause and effect produce additional cost. In this instance what is applicable in mechanics is pertinent in chemistry.

In secondary batteries there are many steps, at each one of which a little is taken from the final result. All the current from the dynamo cannot be utilized in producing the chemical changes; the time intervening between the periods of charging and using causes a loss; the final chemical action will not produce even an amount of current equal to the initial current minus the loss in charging and the time. Something is lost at each step, but just what percentage of the whole has not yet been determined.

The results of a series of experiments carried on at the Conservatoire des Arts et Métiers at Paris form the most authentic account yet obtained of the working of these batteries. They were charged by a Siemens dynamo machine, careful note being made of the required power. The resulting current was used to light the Maxim incandescent lamp, and the return of the cells was about 90 per cent. considered as electrical quantity. But in respect to work done, it was demonstrated that the battery returned only 40 per cent. of the amount required to charge it, and 60 per cent. of the energy actually stored up by it. This refers only to disposable electric energy. It is probable that if the current had been transformed into mechanical work the amount would have been smaller. The power required to charge the battery was equiva-

lent to one horse-power acting during thirty-five hours and twenty-six minutes; only 66 per cent. of the work expended was received by the battery, and only 60 per cent. of this was given back by the battery.

THE DURHAM SYSTEM OF HOUSE DRAINAGE.

There is now on exhibition at the office of ENGINEERING NEWS full-sized models of a new system of construction for house drains, the invention of C. W. Durham, Member American Society Civil Engineers. In this system all of the ordinary plumber's materials and fittings are discarded, and in the construction of the work the plumber's services are dispensed with. To secure an invulnerable connection between the water closet and the street, which shall be permanently independent of malicious or accidental damage from carpenter's nails, settling walls or the numerous causes which operate to render a first-class job of plumbing insecure even before a building is ready to be occupied, the principles of gas and steam engineering are employed. Wrought-iron steam pipe, thoroughly coated inside and out for protection from rust, with screw joints, takes the place of thin cast-iron, plumber's soil pipe; and for the drain heavy cast-iron water pipe, with heavy lead joints calculated to be gas tight under a pressure of 300 pounds to the square inch is used. The soil pipes are screwed into the drain and stand erect without lateral support, not being clamped to walls as required by plumber's soil pipe; and water closets are supported directly from the rigid soil pipe without resting on floors. The entire drainage system is independent of the building for support, and consequently unaffected by settlement or racking, while the weight and character of the materials employed insure durability and security against every contingency. The principle of solid and perfect mechanical construction, combined with thorough ventilation, recommends itself to the common sense of every thinking person as a correct solution of the drainage problem.

This system to the present time has been available only to the public in the Northwest, where it has been placed in over 700 buildings. A company is to be organized in New York to manufacture the material and construct house drainage throughout the Eastern States, and as this system has the professional endorsement of Mr. E. S. Chesbrough, Consulting Engineer to the City of New York, and all other scientific authorities who have examined it, the public can confidently assume that the adoption of the Durham system will make their dwellings secure against all possibility of sewer malaria, not for a year or two years, but for a lifetime, or more correctly, a building's life time.

At the Sanitary Exhibition, at South Kensington, in 1881, the system received the only award for improvements in the construction of house drains from a jury of men the most eminent in their profession.

PERSONAL.

MR. A. J. CASSATT, First Vice-President of the Pennsylvania Railroad, will soon resign that position in October.

SAMUEL M. GRAY, City Engineer of Providence, R. I., has been appointed a member of the State Board of Health.

F. J. PICARD has been elected general superintendent and chief engineer of the Columbus & Maysville Railroad.

COL. F. J. PICARD is General Superintendent and Chief Engineer of the Columbus and Maysville Railroad, with office at Hillsboro, O.

F. C. HAND, recently of the Denver and Rio Grande Railroad, has been appointed Chief Engineer of the San Pete Valley Railroad, with office at Wales, Utah.

DR. WM. MCFADDEN, Chief Engineer of the Philadelphia Water Department, was asked to resign by a 16 to 9 vote of the Councils Water Committee on the 6th inst.

MR. T. H. LEWIS has been appointed Inspector of Track, Bridges and Buildings on the Northern Pacific Railroad, with office at St. Paul, Minn. Mr. Lewis is a graduate of the Towne Scientific School, University of Pennsylvania, and his last position was as assistant to Mr. F. Stataper, Chief Engineer of the Pennsylvania Company.

"DR. A. B. ELLIOTT, our new American Consul, is an intelligent gentleman of about sixty years," says the *Dundas County* (Canada) *Herald*, referring to the well-known proprietor of the Lansingburgh (N. Y.) *Gazette*. "He is a veteran editor and writer, and an effective public speaker of wide celebrity in the United States. We are authorized to state that the recent letters purporting to have been written by him are fabrications."

PRESIDENT ELIOT, of Harvard, has that last best gift to man—tact. At one time his students developed an unpleasant liking for sitting in large numbers upon the fence that surrounds the college yard. The President, not desiring such a thing to become a custom, was at a loss how best to break up this practice. At last, one evening, as he was walking along the sidewalk, and the students were sitting on the fence singing, etc., the president said: "Gentlemen, allow me to congratulate you on having adopted the Yale custom." He was never troubled afterward by students sitting on the fence.

ENGINEER CORPS CHANGES.—The following changes in the stations and duties of officers of the corps of engineers are ordered: Major William H. B. Benyaurd, to Chicago, Ill., to relieve Major Garrett J. Lydecker of the charge of the works under his direction in the State of Illinois. Capt. Alexander M. Miller, to Memphis, Tenn., to relieve Major William H. H. Benyaurd, who will repair to his new station at Chicago, Ill. First Lieut. Henry S. Taber, to Fort Snelling, Minn., to relieve Capt. Edward Maguire as engineer officer of that department. First Lieut. James L. Lusk, to Mobile, Ala. The following named officers will be relieved from duty with the battalion of engineers by the commanding officer of the battalion, and will report as follows: First Lieut. Frederic V. Abbott to Major Oswald H. Ernst, at St. Louis, Mo., for duty under his immediate orders. First Lieut. Thomas L. Casey, Jr., to Capt. William Ludlow, at Philadelphia, Pa., for duty under his immediate orders. Second Lieut. Curtis McD. Townsend, to Lieut. Col. William P. Craighill, at Baltimore, Md., for duty under his immediate orders. Second Lieut. Gustav J. Fibeger, to Whipple Barracks, Prescott, Arizona Territory, to relieve First Lieut. Carl F. Palfrey as engineer officer of that department. First Lieut. Carl F. Palfrey, to San Francisco, Cal.

ENGINEERS AND ENGINEERING IN OTHER LANDS.

(Specially Translated and Prepared from Our Exchanges.)

There is a great deal of talk at present among French engineers of the reorganization of the Corps des Ponts et Chaussées. Not only the engineers themselves complain, but the great body of aids, and what we generally term "chainmen," a goodly army of 6,000. Promotions, too, in this body have been going at the pace of a snail—and of a blind one, too.

The Cologne *Gazette* has another letter especially about engineers employed on the canal. As it will doubtless be interesting to American engineers, it is here literally translated "Gamboa." Of the engineers employed on the Panama Canal, those who occupy high positions passed through the usual State examinations in that country. A few of them were already in Lesseps' service in cutting the Suez canal. In the beginning, great care was taken in selecting the engineers, and a great many English, North Americans and Germans were for this reason refused. After a little while, however, it was perceived that the necessary supply of intelligent, venturesome and hardy men could not be procured from France alone, or that it would not be to the advantage of the canal if so. As conditions now are, I believe that a position would be given to any engineer who could prove his capacity—equally whether he had passed an examination or not. The management cannot be blamed, however, for being cautious in the matter. An instance has been seen here in which a builder, who gave himself out as an experienced one at least, and who received a very remunerative and easy post on account of his agreeable manners, did not know anything about the use of a leveling instrument, and, in all probability, had never even seen one.

The salaries paid the canal engineers are high, from a European standpoint, but then the danger of the climate must be taken into consideration. The European overseers receive from $100 to $150; the ordinary engineers from $125 to $250, and the Division overseers and other high officials from 400 to 500 dollars. [This, in German money, is from 1,600 to 2,000 marks—and sounds big, very big! *Trans.*] American and English, who are not looked upon as being too friendly to the undertaking, consider these salaries as being even too low on account of the climate and cost of living. It would seem to me, however, that the gentlemen who are engaged at such isolated places as Emperador, Gamboa, Gatun, etc., where there are no occasions for great outlay, could very well lay by something handsome. The high prices are only for Panama and Colon, while those engineers who live in out-of-the-way places can build small rent-free houses and have provisions very cheap.

Very few of the houses put up by the company for their engineers are in brick. American woods, planks, etc., all ready cut, have been shipped from the United States. All, or mostly all, are of one story and built on posts. Still they have quite a cheerful appearance, with their green blinds and carved work. It is purposed that later every engineer shall have his own house, containing two or three rooms. The great objection to these houses, at present, is that unless they are provided with wide, projecting roofs, they are almost untenable during the great heat of the day. At night, however, the wind often sounds shrilly through the crevices. In Emperador I saw flower-beds and European vegetables, especially peas and beans. In Gamboa you will find Mr. Carrey's house with baths, mirrors, books and all the articles of modern luxury that a young bachelor can desire. In Gatun Mr. Sharp has a similar house; it is situated on a height, and in case of trouble from a strike, etc., could serve as a fort. All the palm trees, I was happy to see, have been left standing when not strictly in the line of the canal. Mostly all the engineers have a cook for them when living in the same place. To tell the truth, there is not only a great dearth of cooks and female servants here, but of women in general, and most of the engineers are unmarried. We have wines, preserves, etc., from Panama free of duty, and at wholesale prices. As a beverage Vichy water is in great favor, although good water can be had. There are cantines with billiards—places also patronized by the workmen. The prices are low in Gatun. You can have a nourishing dinner, half a bottle of Bordeaux wine and coffee for 70 centavos. The French seem to know how to take care of themselves better, in so far as domestic matters are concerned, than the English and Americans. There are no amusements except what the engineers can provide for themselves, and the danger of giving themselves up to drink is very great. The company will soon allow $40 monthly for a horse, but at present there are hardly any. To show how various are the nationalities employed here, the list of the engineers at Emperador may be given. The division superintendent, M. Jacquemin, who was previously on the Suez Canal and who lives in Panama with his family; Herr Berns, the second division superintendent, is from the Rhenish Province—he worked formerly under Meiggs on the Oroya Railroad; Mons. Lebean is a Parisian, M. Mercier a Swiss, M. Dreyfus an Alsatian, and there is a Vienna gentleman, whose name I forget.

Now, that there will soon be very evidently a lull in the building of railroads in this country, let us hope there may be room for a few of our

engineers—in case they require positions—in the construction of the great works in the East. We shall allude to these more in detail in future numbers of ENGINEERING NEWS, but we may add to those mentioned in our last letter—the cutting of the Straits of Malacca, and the cutting of the Isthmus of Corinth—the latter has just been begun under the direction of General Turr. It would seem that there is a surplus of German engineers just at present, although a large number have lately been engaged in Turkey, where it seems German influence is now in the ascendant. But there is really no reason—except financial ones—why Americans should not pay some attention to the great works which the changing of the transport trade and general commerce of the world are now making necessities.

CORRESPONDENCE.

CORRECTION.

NEW YORK, June 6, 1882.

EDITOR ENGINEERING NEWS:

However "pleasing (it may be) to see one's name in print," yet it it is unpleasant "to have one's name mis-spelt in a bulletin."

The notice you gave of my report on the columns and ceiling of the Assembly Chambers of the Capitol at Albany was but an extract from an Albany paper, with all its faults of typography full upon it.

The notice made it inferential that I had volunteered my opinion, whereas I was summoned in due and ample form to appear at Albany and give my opinion in the matter.

I inclose you a fair copy of the report, should you see fit to correct your notice.

Respectfully,

CHAS. H. HASWELL.

[We publish the report as sent by Mr. Haswell, but we fail to see w here the errors of mis-spelling or other wise, in our notice of last week, on page 185, "come in," except that he is called "superintending" engineer from the card on his envelope, instead of "supervising," from his card on his note head.—ED. ENG. NEWS.]

THE CRUMBLING ASSEMBLY CHAMBER.

Engineer Haswell Certifies that the Supporting Piers have Settled.

ALBANY, May 30.—Assemblyman Benedict has made public the following letter, which confirms, although in guarded language, the opinions already expressed by Federal engineers relative to the instability of the costly Assembly Chamber in the New Capitol:

OFFICE OF CHAS. H. HASWELL,
CONSULTING AND SUPERVISING ENGINEER
AND CITY SURVEYOR,
NEW YORK, June 6, 1881.

SIR: In compliance with your summons I have visited the Capitol building and have examined the ceiling of the Assembly Chamber in its construction and condition, together with the piers sustaining the columns, supporting it. I submit:

The piers have settled, and the integrity of the ceiling is disturbed.

The circumstances that it has been deemed necessary by those fully acquainted with all the elements of the designs, support and structure of the ceiling, to supplement it with a counterpoise and counterfort, would seem to be conclusive that it is admitted to be defective either in design or construction, or both.

In the absence of a base of reference and an instrument of application thereto, it was impracticable for me to arrive at the extent or conformity of the settling of the piers; and in the absence of a copy of the drawings whereby to determine as to the nature and extent of the lateral resistance to thrusts of the ceiling, it was alike impracticable for me to decide upon the general character of the thrust.

Reviewing the elements presented, I am of the opinion that the subject is one involving early attention, and in order to ascertain to what extent and in what manner remedial action is best to be applied, I suggest that it be submitted to the consideration and report of a Board of Engineers and Architects, and if remedial action should be recommended and adopted, that this opportunity will be presented to very materially improve the acoustics of the chamber.

Respectfully,

CHAS. H. HASWELL.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

SETTLING THE DIFFICULTY AT CAMBRIDGE, MASS.—The Water Board has unanimously adopted the following:

Resolved, That after a careful and patient investigation of charges made against Hiram Nevons, Superintendent, by John Miller, foreman, the Water Board decides that the charges made are without foundation, and in no way reflect on the good character or capacity of Mr. Nevons.

WATER-WORKS FOR BUTTE, MONTANA.—The Water Company's men, along the east side of Montana street, have run the preliminary stakes for the 8-in. main down as far as Park. At the northeast corner of Park and Montana streets the line will be run west across Montana street and down by the Caplice building. On the west side only a 2-in. pipe will be put in, room being left on the east side for the extension of the 8-in. main whenever it is thought desirable. In the meantime residents of the southwest quarter of the city may hope for a plentiful supply of water now in a few weeks.

WATER-WORKS WANTED.—Woodbury, N. J., wants a water-works. The City Council has under consideration an offer from John Lockwood, of New York, to build a works at his own expense, put in the most improved pumping machinery, capable of supplying 750,000 gallons of water daily. He will also build a reservoir with a capacity to contain not less than 1,000,000 gallons, and lay three miles of water pipes, and at the expiration of ten years agrees to sell the works to the city.

THE town of Northborough, Mass., last week voted almost unanimously in favor of water-works. The water is to be taken from Boylston and Shrewsbury, some three miles distant, and Messrs. Goodhue & Birnie of Springfield offer to construct the water-works for $50,000. The choice of Water Commissioners was deferred.

IMPROVEMENT AT PITTSFIELD, MASS.—A new six inch iron water main is being laid in Depot street in place of the old four-inch cement pipe.

NEW WATER COMPANY.—Denison, Texas, has a water-supply company. Capital stock, $100,000.

RESERVOIR COMPLETED.—A dispatch from Sedalia, Mo., dated the 3d, says: During the past week the new dam and reservoir of the Sedalia water-works has been completed and thoroughly tested as to strength and capacity. The city now has a supply of water amply sufficient for a city of 50,000 people. The back water of the dam extends in the bed of the stream for a distance of nearly two miles above the dam, and has an average depth of six feet. The dam cost $10,000, and the supply of water for the city is now assured beyond all contingencies.

WATER-WORKS AT LAREDO.—From the *Daily Express* of San Antonio, TEX., we clip the following: Mr. Freeman, of this city, has returned home from Laredo where he made a survey of the contemplated water-works. He approves the water-power as located and established by Brune for the purpose of generating electricity for lighting the city and lifting water into the reservoir. He says the power can be increased, with a little additional expense, to three hundred horse-power. Every arrangement is being made, and an early completion of the much needed work is an assured fact.

MALDEN, Mass., has voted $7,500 to be expended in extending its water-works.

WATER SUPPLY OF PARIS.—The scarcity of water from which Paris suffered last summer is likely to be repeated during the present year. The winter just past was a period of exceptional drouth, and the results of it are not confined to the basin of the Seine. In eastern France the situation is especially distressing. At Kehl the bed of the Rhine is dry in places; the Meurthe was never before so low even in August, and the level of the Moselle and the Meuse has fallen.

GAS TANKS.—The National Tube Works Co., Pittsburgh, are building a cluster of gas tanks for harbor lights for the Beacon Light Co., of Baltimore.

AGAIN AGITATED.—Philadelphia is again disturbed in regard to the pollution of the Schuylkill.

THE READING OF GAS METERS.—A very valuable application of their counting machine has been made by T. R. Harding & Son, Tower Works, Leeds, and one which will no doubt become of universal use. Every one knows how difficult it is to check the reading of gas-meters, and how liable gas-consumers are to be charged for more gas than they believe they have burnt. Messrs. Harding have, after long and persistent experiments, succeeded in making a counting machine at so small a sum as to be able to compete with the index at present in use. By this machine every single foot of gas burnt will be separately registered, and anyone (even a child) can read the figures, and can tell how much gas has been burnt in a given time. The Gas Committee have ordered a number of these indices to be attached to meters for testing, and in due course all meters in Leeds will probably have this "ready reckoner" upon them.—*The Ironmonger.*

THE JOPLIN, MISSOURI, WATER-WORKS COMPANY is putting up a new stand-pipe reservoir. The commissioners appointed upon the petition of the Commissioner of Public Works to appraise the value of land needed for the construction of a new reservoir at Kensico, Westchester County, and of a pipe line or aqueduct, have completed their work. The land to be acquired under this report adjoins Big and Little Rye ponds and the streams flowing out of them. These ponds and streams will yield 1,000,000,000 gallons of water, which will be stored in the new Kensico reservoir.

KEROSENE INSTEAD OF GAS.—An exchange says: Keokuk has discarded gas and made a contract for lighting up their city with kerosene oil at the rate of $16.50 for each lamp-post per annum.

ELECTRICITY.

GAS VS. ELECTRICITY.—The great multiplication of telegraph, telephone and electric light wires has caused a large increase in the expenses of insulators, and to meet this difficulty English inventors have introduced a cheap insulating material called insulite. A method has been discovered by which wood, sawdust, cotton waste, paper pulp and other fibrous materials can be converted into a material perfectly impervious to moisture and acids, easily molded under pressure to any shape, and capable of being worked or cut into any form. The material is an excellent non-conductor of electricity, and can be used for all forms of electrical machinery.—*Ex.*

NEW TELEGRAPH COMPANY.—The Baltimore & Ohio Telegraph Company has filed a certificate of association at Albany, N. Y. The general route of the lines is from New York to Brooklyn, thence across New York Bay to Edgewater, through Richmond County to or near Tottenville. The capital is $100,000.

SECONDARY BATTERIES.—Prof. S. P. Thomson has found that almost any oxide of hydrate of lead will serve in the Faure battery. Litharge will do if it is so finely ground as to be painted on the plates. He obtained the best results by coating the plates with the brown peroxide, but it is a little more expensive than red lead or litharge.

A NARROW-GAUGE electric railway in Fairmount Park, Philadelphia, is proposed. Ex-Gov. Hartranft is one of the promoters, and $200,000 is the capital to be solicited.

ELECTRIC LIGHTS IN RHODE ISLAND.—An important act passed the General Assembly, which will seriously affect electric lighting and telegraph companies. Several acts were introduced for the incorporation of electric-light companies, but the committee to whom they were referred inserted a clause by which city and town councils may order poles and wires down after a formal notice of 30 days.

STREETS, DRAINAGE, ETC.

DITCHES.—Wabash County, Ind., is building $100,000 worth of ditches.

ATCHISON, KAN., is debating as to whether or not she should borrow $15,000 to fix her streets.

RIVERS AND HARBORS

HARBOR IMPROVEMENTS IN WISCONSIN.—The harbor improvements at Menominee this year will necessitate the expenditure of $15,000. Five new cribs and the superstructure over six others will be built; also, repairs to one displaced crib.

DES MOINES DRY DOCK.—WASHINGTON, D. C., June 5.—Representative McCord, of Iowa, to-day introduced a bill appropriating $30,000 for the construction of a dry dock at the Des Moines Rapids Canal on the Mississippi River. The bill was accompanied by letters from the Chief of Engineers and the Secretary of War, advocating strongly the appropriation for the purposes desired.

RAILROADS.

WIDENING THE ROAD.—The Circuit Clerk, of Jo Daviess County, Ill., has recorded a mortgage for a consideration of $920,000 in favor of the Farmers' Loan and Trust Company and against the Chicago & Northwestern Railroad Company, to raise funds to widen the narrow-gauge railroad from Galena to Woodman, Wis., and branches to Platteville and Lancaster, Wis., a distance of 92 miles. The work is already under way and the traveling public will be rejoiced to learn that there will soon be a northwestern broad-gauge connection between this city and Milwaukee and Chicago.

BUYING A RAILROAD.—The Northern Pacific Railroad has purchased from the St. Paul, Minneapolis & Manitoba Railroad the latter's line along the east bank of the Mississippi River, between Wattab and Anoka. The Northern Pacific will now bridge the Mississippi at Anoka, and from that point extend the purchased line into Minneapolis. These changes assure the Northern Pacific a continuous line from Minneapolis to Brainard.

ANOTHER LINE TO ST. PAUL, MINN.—DES MOINES, Ia., June 2.—The work of broadening the track of the narrow-gauge extension of the Chicago & Northwestern extension from Ames to Jewell Junction is completed. This opens up through standard-gauge track from this city to St. Paul via the Chicago & Northwestern. It is expected regular trains will be put between these two points next week. The Northwestern now owns no narrow-gauge track in Iowa.

WORK ABANDONED.—GALVESTON, TEX., June 3.—The *Houston Post* says: "The work of construction on the New York, Texas & Mexican road will be abandoned upon completion of the road to Victoria, which point will be reached about June 17. The inability of the State to make desirable land grants is given as a reason for this decision."

THE SCIOTO VALLEY AND CHESAPEAKE & OHIO'S PROPOSED EXTENSION.—BELLEFONTAINE, O., June 1.—Colonel Fisher, of Columbus, with a corps of twelve assistants, has been engaged the past week in surveying a route from Columbus to Fort Wayne for the Scioto Valley Railroad Company.

ON TO OMAHA.—ATCHISON, KAN., June 2.—The new Missouri Pacific extension from Atchison to Omaha is finished, the last rail having been laid yesterday afternoon at 3:30 o'clock at a point three miles north of Huron, in Atchison County.

THE BROADWAY UNDERGROUND ROAD.—A bond of $100,000 as a guarantee for the completion of the Broadway Underground Railroad was filed in the Comptroller's office on the 2d. The bond will be forfeited if the road is not completed within five years from July 1 last.

A NEW MINNESOTA LINE.—Articles of association for the St. Paul, Minneapolis & Sea Coast Railroad have

been filed. Officers have been elected as follows: Alexander Ramsey, St. Paul, president; Judge Thayer, Clinton, Iowa, vice-president; H. H. Sibley, St. Paul, treasurer. Capital, $3,000,000. The object of the association is to build a line of railway from St. Paul and Minneapolis to eastern and southern connections at Clinton, Iowa, and to tap the coal mines in that section. Preliminary surveys have been made, and the distance is 290 miles as the line is laid out on paper.

NEBRASKA RAILROADS.—The State Board of Equalization reports the total number of miles of railroad in Nebraska at 2,288; total assessed valuation, $14,668,950, an increase over last year of $2,000,000. The Union Pacific and other Gould lines have 897 miles in Nebraska, valued at $6,732,317. The Burlington road and leased lines amount to 914 miles, assessed at $6,010,340.

INCORPORATED AT ALBANY, N. Y.—The Tunnel Extension Company. The road is to run in Atlantic avenue, Brooklyn, about 2,000 feet. Capital, $50,000.

SOUTHERN MINNESOTA LINE.—The Milwaukee & St. Paul Company has placed seven large construction gangs, fitted out with steam plows and other grading implements, along the entire length of its Southern Minnesota route. This track is to be entirely relaid, and all the bridges are to be reconstructed or replaced.

THE NEWTON CIRCUIT RAILROAD.—From the Boston *Journal* of the 2d we learn that on the previous day the directors of the Newton Circuit Railroad filed with the Railroad Commissioners a report made to them by G. R. Hardy, engineer of the Boston & Albany Railroad, relative to the surveys of the road and an estimate of the cost of construction. The proposed route runs from Brookline to Newton Highlands on the southerly side of the Woonsocket division of the New York & New England Railroad, and generally immediately adjacent thereto. The estimated expense is tabulated as follows: Section A, $405,003; Section B, $178,655; total, $583,657.

Unless the negotiations are soon successful that are now pending between the New York & New England Company and the Boston & Albany relative to the purchase of that part of the Woonsocket Branch of the former road between Brookline and Newton Highlands, active work in constructing this line will be commenced. Locations are to be asked for of the Newton and Brookline authorities next Monday.

TO BE EXTENDED.—NEW RICHMOND, O., June 2.—Superintendent Walker and General Agent Henley are here arranging for the immediate extension of the Ohio River Branch of the Cincinnati and Eastern Railroad to Moscow, eight miles east of New Richmond.

MILWAUKEE AND LAKE WINNEBAGO.—The Milwaukee and Lake Winnebago officials have now definitely decided to build from Oshkosh to Neenah. The route between Oshkosh and Neenah will be directly beside the Northwestern track, the west-line fence of the Northwest right of way being the east-line fence of the Milwaukee and Winnebago route.

MISSOURI RAILROAD EXTENSION.—HIAWATHA, Kan., June 1.—The last rail of the Missouri Pacific Extension was laid at Everest, in this county, to-day. A passenger train of railroad men from Atchison will visit Hiawatha to-morrow, and be entertained by our city authorities.

THE Baldwin Locomotive Works are building thirty locomotives for the Reading Railroad.

THE SAVANNAH & PACIFIC SHORT LINE RAILROAD Co. has been organized to build a line from Savannah to Columbus, Ga., about 250 miles. Capital, 3,000,000. Directors, W. W. Wright, Phinehas Prouty, Alexander L. Chew, Joseph S. Lewis, all of Geneva, New York; and F. E. Burk, of Americus, Sumter County, Georgia.

RAILWAY PROPERTY IN LOUISIANA.—From a statement read by Mr. Wheelock, representing the New Orleans Pacific Railway Company, before the Louisiana Legislative Committee on Railroads, at Baton Rouge, on May 31, we take following items: "Of railways which are completed, I may mention the Louisville & Nashville, formerly the New Orleans & Mobile; the Jackson road, the Morgan road, the Louisiana Western—in all comprising 530 miles of railway in the State of Louisiana. The following roads are in process of construction: The New Orleans Pacific, from New Orleans to Shreveport, 325 miles, running through the parishes of Jefferson, St. Charles, St. James, St. John, Ascension, Iberville, West Baton Rouge, Pointe Coupee, St. Landry, Avoyelles, Rapides, Natchitoches, De Soto, Sabine and Caddo. The Arkansas Branch of the New Orleans Pacific, from Alexandria to Knobel, Arkansas, 125 miles in Louisiana, running through the parishes of Rapides, Grant, Catahoula, Caldwell, Ouachita and Morehouse. The Vicksburg, Shreveport & Texas, 200 miles, running through the parishes of Madison, Richland, Ouachita, Jackson, Bienville, Webster, Bossier and Caddo. Northeastern, from New Orleans to Meridian, in Louisiana 50 miles, running through the parishes of Orleans and St. Tammany. Natchez, Red River & Texas, from Vidalia to the Sabine River, 130 miles, running through the parishes of Concordia, Catahoula and Rapides. New Orleans & Mississippi Valley, from New Orleans to Memphis, on the east bank of the Mississippi River, 130 miles in Louisiana, running through the parishes of Orleans, Jefferson, St. Charles, St. John, Assumption, East Baton Rouge, East Feliciana and West Feliciana. Mississippi Valley, from Vidalia to Arkansas City, 102 miles in Louisiana, running through the parishes of Concordia, Tensas, Madison and Carroll. Southern Pacific, known as the Huntington road, from Vermilionville to New Orleans, 130 miles, running through the parishes of Lafayette, St. Martin and Iberville. Showing nearly 1,100 miles of railway projected by responsible parties.

RAILROAD property in Georgia increased two and a quarter million dollars in value last year.

A BIG SALARY.—The trunk-line presidents have advanced Pool Commissioner Fink's salary to $30,000 per year.

A STREET railway is to be built at Columbus, Miss.

RAILROAD BUILDING IN THE UNITED STATES.—The *Railway Age* says the impression prevails that the building of railroads has fallen off this year from the enormous total of last year, which was between nine thousand and ten thousand miles. The fact is that during the first five months of 1882 there have been built on one hundred and twenty lines of railroad 3,480 miles of track. Considering that only 1,500 miles had been built at this time last year and that building increases rapidly the latter half of the year it would be a logical conclusion that the total of this year's building operations would be 23,000 miles, but, of course, this figure will not be reached. There are at least three hundred and fifty lines, covering, at a moderate estimate, a total of 25,000 miles, upon which work is either now in progress or is proposed to be commenced during the present year.

[Comparatively few new railroads are being projected this year and it is probable that the mileage of construction will be less this year than it was last.—EDITOR ENGINEERING NEWS].

WORK COMMENCED.—Construction has been begun on a projected road between Vera Cruz and the Pacific Ocean.

CANALS.

THE LOUISVILLE WATER POWER AND IMPROVEMENT COMPANY.—Hon. Proctor Knott, President, and Col. S. Taylor, Superintendent, of this company, have been on an extended tour through New England to examine into the utilization of water power in that industrious section of the country.

PROMOTERS OF THE HENNEPIN CANAL bill will endeavor to have it inserted in the River and Harbor bill.

CONTRACTS LET.

PIKE CONTRACTS LET.—Proposals for the grading, graveling, stonework, culverts and bridges of certain pikes were received by Samuel Craig, C. E., at Wapakoneta, Ohio, on May 31. The following awards have been made: Elliott Pike sold to A. P. Rinehart, of Uniopolis, Ohio, for $6,931. Barth Pike sold to William Barth, of New Bremen, O., for $9,750. Amsterdam Pike sold to Lewis F. Wellman, of New Bremen, O., for $1,650. Cumberland Pike sold to Reed, Berry & Martin, of Versailles, O., for $5,880. Geyer Pike sold to Wilson L. Bailey, De Loss P. O., Auglaize County, Ohio, for $8,900.

PAVING CONTRACT LET.—The contract for paving Congress avenue, New Haven, Conn., from Cedar street to Bond street, with Telford pavement has been awarded to Messrs. C. W. Blakeslee & Son. A portion of Brewery street is soon to be paved with Belgian blocks.

CONTRACTS FOR CONSTRUCTION.—NORWALK, O., June 1.—Contracts for the construction of the Wheeling & Lake Erie shops here have been let to D. K. Creamer & Co., of Toledo, for $20,000, exclusive of foundations, which are to be done by the yard. Work will begin at once, and will be pushed with all possible rapidity.

STREET CONTRACTS LET IN ST. PAUL, MINN.—The Board of Public Works has let the contract for grading Tenth street from Lafayette avenue to Jackson street to Simar & Morton at $9,850, and that for constructing a sewer on Third street was given to A. J. Cooper for $2,497. The award of contracts for paving Seventh street from Jackson to Kittson was laid over. The lowest bid was that of L. H. Patchen, $22,895.

BUILDINGS.

PUBLIC BUILDINGS.—The Senate has passed bills authorizing the construction of four new public buildings; one at Concord, N. H., at a cost of $200,000; one at Pensacola, Fla., at a cost of $200,000; one at Marquette, Mich., at a cost of $100,000, and one at Brooklyn, N. Y., at a cost of $800,000.

NEW HOTEL.—Nineteen thousand dollars has been subscribed towards building a new hotel in Georgetown, Ky.

THE SOUTHERN PACIFIC SHOPS, to be located in Houston, Tex., are to cover an area of 1,800x1,200 ft., and include the following departments: A round-house with 44 stalls to accommodate 44 locomotives; an office, 30x60; oil-house, 25x50; store-room, 30x100; machine shop, 100x300; transfer table and pit, 50x348; foundry, 70x240, with two cupolas; brass foundry, 25x60; engine room, 30x50; paint shop, 70x200; iron-house, 30x30; blacksmith shop, 80x165; boiler shop, 80x75; car-shop, 100x300, with coal bins, large water tanks, etc., equal to the supply of this vast enterprise.

THE corner-stone of the new $3,000,000 Produce Exchange to be built in this city was laid on the 6th, with the usual interesting ceremonies of such occasions.

PASSENGER DEPOT.—The Detroit *Free Press* says: "It has been definitely decided that a new passenger depot shall be built in this city for the Michigan Central Railroad Company upon the site of the present structure. The new depot will cost $140,000 to $150,000, but work will not be commenced until after Mr. Vanderbilt returns from New York and approves the plans, which will probably postpone active operations until the last part of June, certainly till after the 15th." When will Mr. Vanderbilt join with the other road on the Lake front and put up a first-class depot to take the place of that dismal little trap at the foot of Lake street?

SOCIETY BUILDING.—A fine building is soon to be erected by the Sigma Phi Society of Williams College, at a cost of $50,000.

NEW HOTEL, THIS CITY.—Plans have been filed in the Bureau of Buildings by Robert and Ogden Goelet for a new and extensive hotel, which they intend to build on the northest corner of Broadway and Forty-third street.

EXPENSIVE VILLA.—A contract has been signed for building a $50,000 villa at Ochre Point, R. I., for Prof. Charles W. Shield, of Princeton College.

NEW ORLEANS is experiencing a building boom, over $2,500,000 having so far been invested in new buildings the present season.

THE new depot at Atchison, Kan., will be begun soon.

LABOR.

A NEAT BONUS.—Winston Brothers, the contractors on the Chippewa Falls & Northern road, offered their employés $1,000 if they would complete the grade between Chippewa Falls and Bloomer by June 1. The grade was completed, and the men therefore secured the bonus.

CUTTING DOWN FORCES.—A general reduction of forces is taking place all over the country. But a few months ago the people were ready to condemn the Iron Mountain management for reducing forces. In regard to cutting down of forces the Cincinnati *Enquirer* says that the Wabash has cut off every employé that could be spared, and in Indianapolis even went so far as to order the telephone out of their local office. On the Pennsylvania Company's lines west of Pittsburgh, within the past thirty days 3,500 men have been discharged, 1,000 of whom were on the Pittsburgh, Cincinnati & St. Louis alone. Extra trains have been taken off the lines, and every leak has been stopped. This week six train gangs were taken off the Indianapolis & St. Louis road, and the yard force on all lines has been reduced. Other precautionary measures against a shortage in earnings have been taken, all indicating an unusually dull business and consequent light receipts.

LARGE PAY-ROLL.—When the Pennsylvania Railroad shops in Altoona are in full operation they employ 3,500 men, and the pay-roll reaches $170,000 per month. The estimated value of the Pennsylvania shops at that point is $30,000,000.

WAGES IN BOSTON.—The Aldermen of Boston have concurred in an order authorizing a 5-per-cent. increase in laborers' wages, provided that the sum be not less than $1.80 a day or greater than $2.10.

BRIDGES.

THE KEYSTONE BRIDGE Co. is putting up a new bridge over the Monangahela River, at Brownsville, Pa., for the Pennsylvania R. R. Co.

THE FORTH BRIDGE.—The bill for the construction of the Forth Bridge has been passed by a Select Committee of the House of Commons. It is estimated that 43,000 tons of steel will be used in its construction, and that it will cost £1,750,000.

A MINNEAPOLIS BRIDGE.—The three iron spans for the new Plymouth avenue bridge are now in place, and the structure is accommodating the travel in that portion of the city. The employés of the Canton Bridge Company are also attaching the sidewalk to the completed spans.

A VIRGINIA BRIDGE REPAIRED.—Mayo's Bridge, over the James, at Richmond, is being thoroughly overhauled and repaired.

BRIDGE TO BE BUILT.—The fine bridge at Emerson, carried away by the floods on the Red River, is to be replaced by an iron structure to cost $45,000, of which the Dominion government gives $30,000, the city of Emerson $10,000, and Manitoba $5,000.

RAILROAD BRIDGE.—WASHINGTON, June 1.—The bill passed authorizing the construction of a railroad bridge across the Sault Ste. Marie River, between Lake Superior and Lake Huron, with the purpose of connecting with the Canadian railroads.

A NEW JERSEY BRIDGE FINISHED.—The cars crossed the bridge to Sea Isle City for the first time on June 2.

NEW MASSACHUSETTS BRIDGE.—The selectmen of Amherst have ordered of the Corrugated Iron Company of New Britain, Ct., an iron bridge to take the place of the wooden one across Freshmen River at Mill Valley, and expect to have it in position by August.

NEW IRON BRIDGE.—A joint committee representing the city and town of New Haven, Conn., have authorized the City Engineer to make the necessary surveys, and to prepare plans and estimates, for a new iron bridge to replace the old structure known as Tomlinson's bridge. The location of the bridge is at the head of the harbor, where it is joined by the Quinnipiac River, and near the wharves of the New York & New Haven Steamboat Company. The proposed bridge will be about 400 ft. in length, and will probably consist of two fixed spans of about 125 ft. each, and a pivot span of about 150 ft.

THE PITTSBURGH BRIDGE COMPANY have orders for twenty new bridges and work enough ahead to employ their men for four months, day and night.

CONTRACTS.

LT. COL. THOS. LINCOLN CASEY, U. S. Engineer, Washington, D. C., will receive proposals for an hydraulic elevator till June 20.

MISCELLANEOUS.

THE LARGEST ISSUE.—The Patent Office on the 6th issued 412 regular patents, 11 designs, 6 reissues, 15 certificates of registration, and 7 certificates of registration of labels. The receipts from the above source were $15,002. This is the largest weekly issue ever made by the office.

INCORPORATED.—The Northwestern Iron Company of Duluth, Minn., filed articles of incorporation with the secretary of State. The capital of the company is $20,000 divided into 800 shares of $25 each. The incorporators are F. S. Farr, Lars Nelson and R. S. Root of Muskegon, Mich., and Joshua Evarts of Duluth.

THE TUNNEL under the Boston Mountains, Mo., will be completed by July 1.

DURANGO IRON MOUNTAIN.—The wonderful mountain of iron ore two miles northwest of Durango, Mexico, has been purchased by a California firm for $150,000. Twelve months ago the mountain could have been bought for $20,000. So says the *Age of Steel*.

THE BATH-HOUSE COMMITTEE of the city of New Haven, Conn., have decided to have an additional floating bath-house, and have located it on Mill River at the foot of Beech street. The plans are now being prepared at the office of the City Engineer.